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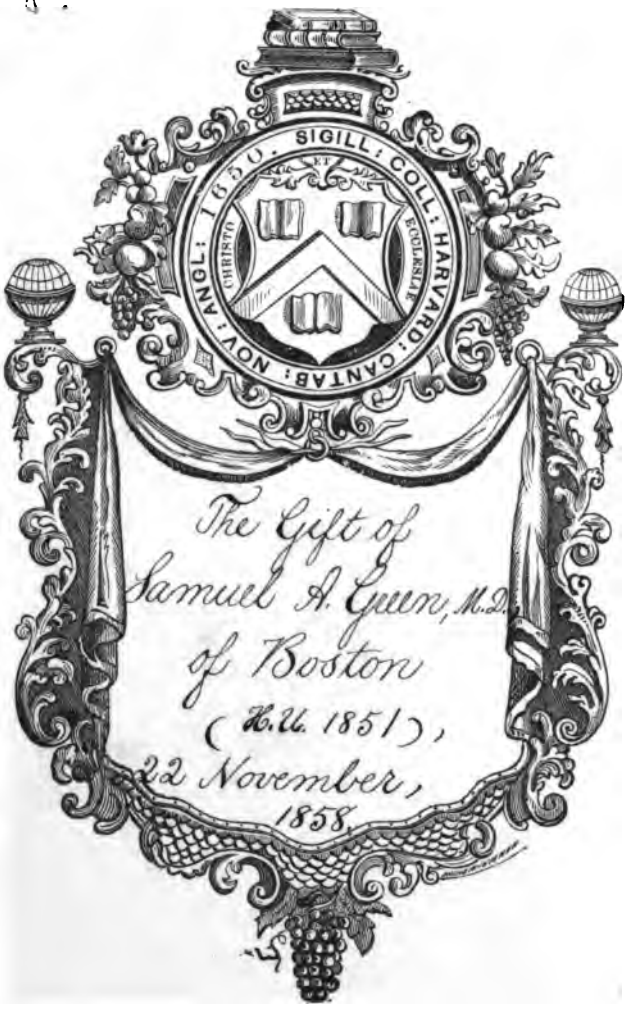
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INTERNATIONAL EXCHANGES

LETTER

To the Honorable Hannibal Hamlin

Chairman of the Committee of Commerce of the United States' Senate

BY

ALEXANDER VATTEMARE.

INTERNATIONAL EXCHANGES

LETTER

TO THE

Honorable Hannibal Hamlin

Chairman of the Committee of Commerce in the United States' Senate

BY

ALEXANDER VATTEMARE

ACCOMPANIED BY

AN HISTORICAL POPULAR DESCRIPTION

IN ENGLISH AND FRENCH

OF THE

METRICAL DECIMAL SYSTEM

BY

Mr WILLIAM W. MANN,

Citizen of the United States

AND

REPORTS

BY

Mr SILBERMANN

Superintendent of the *Conservatoire des Arts et Métiers*

AND BY

Mr DURAND

Commissary General of Coins and Medals

ON

THE STANDARD WEIGHTS, MEASURES AND COINS

EXCHANGED BETWEEN THE GOVERNMENTS OF

FRANCE AND THE UNITED STATES

OF AMERICA

PARIS

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N. York.

To the Hon. Hannibal Hamlin

Chairman of the Committee of Commerce in the United States' Senate.

Central Agency for International exchanges.
December, 12, 1853.

SIR,

It was by the initiative of the Committee of commerce and by a resolution (approved June, 30, 1848) that Congress entrusted to me a complete series of the United States standard weights and measures, to be presented to the Government of France. It is through the same Committee therefore that I have to convey the grateful acknowledgments I am to address to Congress in the name of the french Government.

When, in the month of March, I informed the minister of agriculture and commerce of the donation of Congress I had to present to him, Mr Schneider, then at the head of that department, wrote to me, on the 24th of the same month.

« SIR,

« The french nation congratulates itself on being in possession of this « additionnal series of foreign standard weights and measures, which we « owe to your mediation. I beg of you to convey our thanks for the same « to the american Congress and to have the cases containing them forwarded to the *Conservatoire des arts et métiers*, where they will be placed « in the gallery of prototypes. I inform you at the same time that I keep « at your disposal a series of the three principal standard weights and « measures of France, constructed by the late Mr Gambey, member of the « Institute. I am happy, Sir, to use your agency for the presentation of this « collection, in the name of France, as International Exchanges, to the « Congress of the United States of America. »

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A Monsieur Hannibal Hamlin

Président de la Commission du Commerce, Sénat des États-Unis.

Agence centrale des échanges internationaux.
Paris, le 12 décembre 1853.

MONSIEUR LE PRÉSIDENT,

C'est sur l'initiative de la Commission du commerce, et par suite d'une résolution du 30 juin 1848, que le Congrès m'a confié une série complète des étalons des poids et mesures des Etats-Unis, pour les présenter au Gouvernement français. C'est, en conséquence, par l'intermédiaire du même Comité qu'il est de mon devoir d'adresser au Congrès les remercîments du Gouvernement français. Lorsqu'au mois de mars 1851, j'informai M. le ministre de l'agriculture et du commerce des dons du Congrès que j'avais à lui offrir, M. Schneider, alors ministre, m'écrivit, sous la date du 24 du même mois :

MONSIEUR,

« La nation française ne peut que se féliciter de posséder cette nouvelle « collection de poids et mesures étrangers dont il doit, sans doute, l'hom- « mage à votre intervention ; et je vous prie, Monsieur, d'en faire agréer « mes remercîments au Congrès de l'Union américaine. Je vous serai obligé de « vouloir bien faire remettre au Conservatoire des Arts et Métiers les caisses « restées en dépôt au chemin de fer de Rouen, et dont le contenu prendra « place dans la galerie des Prototypes. De mon côté, je m'empresse de vous « annoncer que je tiens à votre disposition une collection des trois princi- « paux étalons de poids et mesures français, construits par feu Gambey, « membre de l'Institut; et je me fais un véritable plaisir d'employer votre

In obedience to the above letter I delivered, in the first days of April 1851, the series of american weights and measures, to the Superintendent of the *Conservatoire des arts et métiers*. And it was the new minister, Mr Buffet, who acknowledged their receipt, on the 24th of May of the same year, in the following terms :

« Sir,

« My department has received the set of standard weights and measures, « as well as the balances of precision you presented to it in the name of the « Congress of the United States of America ; and this collection is now the « most important in the gallery of prototypes founded in the *Conservatoire* « *des arts et métiers*.

« Desirous of responding, as fully as it is in my power, to this testimo- « nial of international good will, I have decided to place at your disposal, « for the United States : 1° one of the series, by the late Mr Gambey, compo- « sed of the three units of the metrical system of weights and measures, the « *metre*, the *litre* and the *kilogramme* ; 2° an atlas of the french weights « and measures ; 3° a series of the instruments for weighing and measuring, « which generally compose, in France, the office of verification ; 4° a vo- « lume containing the law which establishes the metrical system in force in « our country, and the ordinances and instructions published to ensure its « execution. I invite you, Sir, when communicating this decision to Con- « gress, to transmit also the expression of my thanks for the valuable se- « ries received by my department. I am aware, Sir, that it is to your lau- « dable and persevering efforts to establish between civilized nations a re- « ciprocity of international donations, that we are indebted for this exchange « accomplished by your kind mediation.

« Knowing therefore, the ardent zeal vith which you have devoted your- « self to the realization of this noble thought, I entrust to your care the « mission of presenting to Congress the gifts of which you were the first to « suggest the idea. »

(Signed) Buffet, *minister of agriculture and commerce.*

Mr A. Vattemare.

By the above, you see, Mr Chairman, that this minister adds considerably to the presents made by his predecessor, Mr Schneider ; that the states men who succeeded one an other in the department of agriculture and commerce, were animated by the same feelings of gratitude towards Congress, and by the same desire to give the most striking testimonials, in their power, of their fraternal good will.

I feel most happy, Mr Chairman, to have been selected to serve as the

« intervention pour l'offrir, de la part du Gouvernement français, à titre
« d'échange international, au Congrès de l'Union américaine. »

Conformément à la lettre ci-dessus, je délivrai, dans les premiers jours d'avril 1851, la collection des poids et mesures américains au conservateur du Conservatoire des Arts et Métiers ; et ce fut le nouveau ministre, M. Buffet, qui, le 24 mai de la même année, m'en accusa réception en ces termes :

MONSIEUR,

« Mon département a reçu la série de poids et mesures, ainsi que les
« deux balances de précision, que vous lui avez offerts au nom de l'Union
« américaine ; et cette collection est aujourd'hui une des plus belles et des
« plus importantes de celles que possède le dépôt des prototypes, établi à
« Paris, au Conservatoire des Arts et Métiers. Désirant répondre, autant
« qu'il était en mon pouvoir de le faire, à ce témoignage de bienveillance
« internationale de l'Union américaine, j'ai décidé qu'il serait mis à votre
« disposition, pour lui être offerts : 1° une des collections construites par
« feu Gambey, membre de l'Institut, et qui se compose des trois unités du
« système métrique des poids et mesures : le *mètre*, le *litre* et le *kilo-*
« *gramme* ; 2° la série des instruments de pesage et de mesurage qui com-
« pose habituellement en France un bureau de vérification, et dont vous
« trouverez ci-jointe la liste ; 3° un atlas des poids et mesures français ;
« 4° un volume contenant la loi qui a remis le système métrique en vigueur
« dans notre pays, et les ordonnances et instructions publiées pour en as-
« surer l'exécution. Veuillez, je vous prie, en portant cette décision à la
« connaissance du Congrès américain, lui transmettre l'expression de tous
« mes remercîments pour la précieuse collection que mon ministère a reçue.
« Je sais, Monsieur, que c'est à vos louables et persévérants efforts pour
« établir entre les nations civilisées une réciprocité de dons internationaux,
« que l'on doit attribuer l'échange qui s'accomplit aujourd'hui par votre
« intermédiaire ; et c'est parce que je connais le zèle ardent avec lequel
« vous vous êtes consacré à la réalisation de cette pensée, que j'ai confié à
« vos soins officieux la mission de faire agréer au Congrès l'offre qui répond
« à l'envoi dont vous avez le premier suggéré l'idée. »

(Signé) BUFFET, *ministre de l'agriculture et du commerce.*

M. A. Vattemare.

Par ce que vous venez de lire, vous voyez, Monsieur le Président, que ce ministre ajoute considérablement aux présents faits par son prédécesseur, M. Schneider ; que les hommes d'Etat qui se sont succédé au ministère de l'agriculture et du commerce étaient animés des mêmes sentiments de reconnaissance pour le Congrès et du même désir de donner, autant que cela était en leur pouvoir, les plus frappants témoignages de ce bon vouloir. Je suis heureux, Monsieur le Président, d'avoir été choisi comme l'humble média-

humble medium between two great nations for an exchange which cannot fail to strengthen the bonds of ancient friendship existing between the United States and France.

I have thus, Sir, been instrumental in placing visibly, side by side, in Paris and in Washington, the french and american systems of weights and measures. Their respective merits may be readily and fully examined, and how naturally arises, here, the wish, on my part, that they should be compared together, and that the one which, upon deliberate investigation, should be found to unite most of the qualities desirable for particular use, and general adoption, the one that should be found, by the principle of its construction, most susceptible of those improvements which would give it absolute perfection, should be adopted by all?

How greatly would such a result facilitate international commercial relations! How much more intimate, and fruitful, would these relations become, promoting, by closer ties of interest and affection, the perpetuation of peace so essential to national happiness, prosperity, and progress! Does not such a result, Mr Chairman, enter rigorously into the design and scope of the system of which I have been long recognized as the humble but faithful promoter; and as the agent of which I have transmitted, between the governments of France and the United States, the national presents which are the subject of this letter? I am satisfied that I do not err in the conviction that it does; and in this belief, Mr Chairman, I have procured, and appended to this letter, and I beg that they may be considered as part of the same, three documents descriptive of the particular collection sent by France to the United States, and explanatory of the french system of weights measures and currency.

The first is a memoir from the pen of Mr W.-W. Mann, a citizen of the United States who has been for several years resident in Paris. Knowing that this gentleman had made of the french metrical decimal system a particular study, and that he was persuaded, equally with myself, of the immense benefits that would result to the world at large, and specially to his own country, from the acceptance, by all nations, of one common system of weights measures and currency, I begged of him to prepare a memoir to be annexed to this letter. His memoir describes, first the objects composing the collection of french weights and measures now in Washington, and then gives a lucid history and explanation of the french system; at the close Mr Mann advances some objections and suggests several amendments which appear to me worthy of serious consideration, if the question of the adoption, by all nations, of some common system ever be brought, as I cannot but hope it soon will be, before the people and the Congress of the United States.

The second is a report drawn up by Mr Silbermann, superintendent of the *Conservatoire des arts et métiers* at Paris, containing the minutes of the operations performed for the verifications of the standards composing the collection sent to the United States by France, and also a concise description of the extraordinary precision of the balances prepared by professor Bache, exhibiting his superior tact and skill, which have given your gift to France such great value in its archives.

The third is a memoir on french coins and coinage, of which Mr Durand, Commissioner general of coins and medals, is the author. It was written expressely to accompany Mr Silbermann's report on the weights and measures, just mentioned. These two documents were also prepared at my re-

teur entre deux grandes nations pour un échange qui ne peut manquer de resserrer les liens de l'ancienne amitié qui existe entre les Etats-Unis et la France.

Ainsi, Monsieur, j'ai concouru à placer visiblement, côte à côte, à Paris et à Washington, le système de poids et mesures français et américains, dont le mérite réciproque peut ainsi être examiné facilement et à fond. Vous comprendrez que je formule ici le vœu que les deux systèmes, ainsi que ceux de toutes les autres nations civilisées, puissent être comparés, de sorte que celui qui, après un examen approfondi, serait, par les principes de sa construction, reconnu comme le plus susceptible de recevoir les améliorations qui le conduiraient à une perfection absolue, soit adopté par tous les pays.

Combien un semblable résultat rendrait plus faciles les relations commerciales de nation à nation ! Combien ces relations deviendraient plus intimes et plus avantageuses ; car, en resserrant les liens des intérêts et de l'affection, elle assurerait le maintien de la paix, paix si essentielle au bonheur, à la prospérité et au progrès des peuples ! Un tel résultat, Monsieur le Président, n'entre-t-il pas rigoureusement dans la sphère d'opérations du système dont je suis reconnu depuis longtemps comme l'humble mais fidèle missionnaire ? N'est-ce pas comme agent de ce système que j'ai échangé, entre les Gouvernements de France et des Etats-Unis, les dons qui font l'objet de la présente lettre. Je ne crois pas me tromper en assurant que ce but rentre dans les attributions de mon système ; aussi, Monsieur le Président, me suis-je procuré, et ai-je joint à cette lettre, comme ne faisant qu'un tout avec elle, trois rapports descriptifs sur la collection envoyée aux Etats-Unis par la France, et sur le système français des poids, mesures et des monnaies.

Le premier de ces Mémoires a été composé par Mr W.-W. Mann, citoyen des Etats-Unis, qui habite Paris depuis quelques années. Comme je savais qu'il avait fait du système décimal métrique français une étude particulière, et qu'il était convaincu, comme moi, des immenses bienfaits qui résulteraient, pour le monde en général, et pour son pays en particulier, de l'adoption, par toutes les nations, d'un système commun de poids et mesures et de monnaies, je le priai de préparer un Mémoire pour être joint à ma lettre. Dans son travail, Mr Mann décrit : d'abord les articles qui composent la collection des poids et mesures de France actuellement à Washington ; il donne ensuite une histoire explicative du système français ; enfin, il soumet quelques objections et propose des améliorations qui me semblent dignes d'une sérieuse attention, si, comme je n'en doute pas, la question de l'adoption, par toutes les nations, d'un système commun, est bientôt portée devant le peuple et le Congrès des Etats-Unis.

Le second rapport est l'œuvre de M. Silbermann, conservateur au Conservatoire des Arts et Métiers, à Paris ; il contient le procès-verbal de la vérification des étalons composant la collection envoyée par la France aux Etats-Unis, ainsi qu'une description concise de la précision extraordinaire des balances préparées par le professeur Bache, précision qui donne une si grande valeur au don que vous avez fait à la France.

Le troisième Mémoire sur le système monétaire français est écrit par M. Durand, commissaire général des monnaies et médailles. Il a été fait expressément pour suivre le rapport de M. Silbermann, sur les poids et mesures. Ces deux derniers Mémoires ont également été préparés sur ma de-

quest and intended to accompany the collection of standard weights and measures already forwarded. They have been printed (in french) and delivered to me by order of the minister of the interior, for distribution among the several Governments of Europe and America, with which our agency for international exchanges, is in regular intercourse.

Allow me, Mr Chairman, respectfully to ask the publication of this letter and the accompanying papers, among the documents of Congress. I trust your honorable Committee will have no objection to give this satisfaction to the distinguished authors of those papers, and take this opportunity to promote, in the United States, aknowledge of the weights, measures and currency of France.

Allow me also to ask, if the above request should be complied with, that 500 copies of the letter and documents appended to it, be held at my disposal to be distributed throughout Europe, where the dissemination of them, in that form, would, I think, be useful and would evince the readiness and the liberality with which the american Congress encourages investigations which have public utility for their object.

I have the honor to be, with great respect,

Mr Chairman,

Your very humble and obedient servant,

ALEXANDER VATTEMARE.

mande et doivent accompagner la collection d'étalons envoyée aux Etats-Unis. Ils ont été imprimés en français et m'ont été délivrés par ordre de M. le ministre de l'intérieur, pour être distribués aux divers Gouvernements de l'Europe et de l'Amérique avec lesquels notre agence pour les échanges internationaux entretient des relations régulières.

Permettez-moi, Monsieur le Président, de demander respectueusement la publication, dans les documents du Congrès, de la présente lettre et des trois Mémoires qui l'accompagnent. J'ai la confiance que votre honorable Comité ne verra pas d'objection à donner cette satisfaction aux auteurs distingués de ces travaux, et s'empressera de saisir cette occasion pour répandre, dans les Etats-Unis, la connaissance des poids et mesures et des monnaies de France. Si le Sénat daignait se rendre au vœu que je viens d'exprimer, je demanderais que 500 exemplaires de la lettre et des documents qui y sont joints fussent mis à ma disposition pour être distribués en Europe, où, selon moi, il serait utile de les répandre sous cette forme, ce qui donnerait une preuve de la promptitude et de la libéralité avec lesquelles le Congrès américain encourage toutes les recherches qui ont un caractère marqué d'utilité publique.

Je suis avec respect,

MONSIEUR LE PRÉSIDENT,

Votre très-humble et très-obéissant serviteur,

ALEXANDRE VATTEMARE.

LETTER

ON

THE FRENCH METRICAL AND DECIMAL SYSTEM

OF WEIGHTS, MEASURES AND CURRENCY

William Wilberforce
W. W. MANN.

Paris, october, 10, 1853.

MY DEAR SIR,

I hasten to comply with the flattering request you have made, that I should prepare a Memoir to be appended to the letter which you are about to address to the Honorable Chairman of the Committee of commerce of the United States' Senate, touching the sets of weights and measures, which, through your enlightened agency, the Governments of our respective countries have recently exchanged with each other. You desire, first, that I should notice the beautiful collection of types and prototypes presented by France to the United States, and then add a plain popular description of the admirable system of which these types and prototypes are the visible signs, the material realization. Most gladly do I attempt what you desire, pleased whith the hope that in so doing I may at once gratify a highly esteemed friend, humbly cooperate, for a moment, in the philanthropic work of peace and good will so identified with your name, and render real service to my own noble country, by aiding in making it acquainted with the *metrical decimal system* of weights, measures and money, — a system, which, to the immortal glory of France, posterity, I have no doubt, will ever recur to, as having brilliantly opened the wonderful era of improvement in the midst of which we live. You will permit me, my dear Sir, to adopt the epistolary form which best comports with the plain unpretending character of the remarks I shall have to make.

I visited the Conservatory of Arts and Trades (*Conservatoire des Arts et Métiers*) of Paris,— an institution analogous to our own *Patent-Office*, — shortly after the arrival of the set of weights and measures presented by the United States to France. An honorable place, in an appropriate hall, had been assigned to it by General Morin, member of the Institute and Conservator of that magnificent establishment. I remember, upon that occasion, listening with much gratification and pride, as an American, to the compli-

LETTRE

SUR

LE SYSTÈME MÉTRIQUE DÉCIMAL FRANCAIS

DES POIDS, MESURES ET MONNAIES

PAR

W. W. MANN.

Paris, 10 octobre 1853.

MON CHER MONSIEUR VATTEMARE,

Conformément au désir que vous avez bien voulu me témoigner, je m'empresse de rédiger un Mémoire pour être joint à la lettre que vous vous proposez d'adresser à M. le Président de la Commission du commerce du Sénat américain, concernant les collections des poids et mesures qui ont été récemment échangées entre les Gouvernements de nos deux pays, échange dont vous étiez, Monsieur, le zélé intermédiaire. Vous m'avez demandé d'abord quelques notes sur la belle collection de types et prototypes, présentée par la France aux Etats-Unis, et puis une description simple et populaire du système vraiment admirable, dont ces types et prototypes sont les signes visibles, la réalisation matérielle. C'est très-volontiers, Monsieur, que je me rends à votre désir, et je me plais à croire qu'en m'associant ainsi pour un moment à l'œuvre philanthropique à laquelle votre nom se rattache si intimement, j'aurai le double avantage de faire plaisir à un ami bien estimé, et de rendre un véritable service à mon noble pays, en y répandant la connaissance des poids, mesures et monnaies composant le système décimal métrique de la France. Je n'en doute pas, Monsieur, ce système, aux yeux de la postérité reconnaissante, se dessinera brillamment au commencement de cette ère merveilleuse de progrès, au milieu de laquelle nous vivons. Ce sera une gloire de plus pour la France. Vous me permettrez, mon cher Monsieur, de garder la forme épistolaire, qui convient le mieux au caractère simple et peu prétentieux des remarques que j'aurai à faire.

J'ai visité le Conservatoire des Arts et Métiers de Paris — institution analogue au Patent Office américain — peu de temps après l'arrivée à leur destination de la collection de poids et mesures, offerte à la France par les Etats-Unis. Une place convenable lui avait été assignée dans la galerie des poids et mesures de ce magnifique établissement. Je n'ai point oublié les paroles bienveillantes et flatteuses dont s'est servi, dans cette occasion, en parlant du don américain, M. le général Morin, membre de l'Institut et administra-

mentary remarks of Gen. Morin, in allusion to the donation of the United States. He spoke of our collection as remarkable specimens of beautiful, and finished workmanship, and of admirable invention, in many of their details, comparing most favorably with those of other nations, and even with those of France.

Subsequently, I visited the Conservatory again, to examine the beautiful and valuable set of french weights and measures, prepared by order of the french Government, for presentation to the United States. It was placed apart, preparatory to being packed, for forwarding to Washington. A handsome inscription, in letters of gold, indicated its destination. As I looked upon this collection of weights and measures composing the metrical decimal system of France, and remembered upon what certain scientific principles that system is based, how nearly perfect it is as whole, how concordant in all its parts, how simple, how convenient, I could not avoid the expression of my admiration, and also of my earnest hope that the time was not remote, when all civilized nations, discarding prejudices, would abandon their antiquated, multifarious, ill constructed, inconvenient, conflicting systems, and moved by an intelligent comprehension of their own, and the common interets, would frankly adopt the metrical decimal system of France. This system bears a fine catholic stamp which recommends it to universal adoption. In fitting it for the private wear of France, its essential universality of character was not impaired. It may be readily adapted to fit the world. ***The world should put it on.*** That, such is the nature of the system, will be clearly shown by the explanation of it which I propose to give in the sequel of this letter. There are thousands and thousands, highly intelligent men too, in the United States, who do not understand this system, and who have been deterred by its greek et latin nomenclature and the presumed difficulties of its scientific structure, from bestowing upon it the little time necessary for its comprehension. I trust, my dear Sir, that presented as they will be, under the auspices of your patronage, my remarks upon this system will find numerous readers, who would otherwise pass them by. I trust that our legislators at Washington will examine the collection of french weights et measures, deposited in the ***Patent Office***, and, then, seriously ask themselves how they may do our eminently commercial country, whose law givers they are, more signal and lasting service, than by abolishing the wretched bundles of customs (I cannot call them systems) which prevail in the United States, and placing upon our statute-book, as the law of the land, the ***Metrical decimal system of weights, measures and money?*** If we adopt it, the other nations will almost certainly do so. England herself, whose cooperation is so desirable and so necessary, would quickly follow. She will never take the lead of us in this reform. While the nation, now the second, and which will soon be the first commercial nation of the earth, holds back, England will not advance. Palpable as is the expediency, great as are the interets which command advance, some stronger inducement must be applied. That inducement would exist — and almost in the measure of compulsion—if we; with whom her commercial relations are of such great and constantly increasing importance, were to anticipate her in the adoption of the metrical system. England, France, and the United States having adopted it, the other nations, of primary and secondary rank, which still keep aloof, would, of course, and almost of necessity, accede. And then we should witness the first practical illustration, the first great recognition, by uni-

teur du Conservatoire des Arts et Métiers, qui nous a fait les honneurs de l'établissement. Il cita les objets de notre collection comme chefs-d'œuvre d'habileté, remarquables par le fini de leur exécution, et par une très-heureuse invention pour beaucoup de leurs détails. Sous ces rapports, disait le général, ils n'auraient rien à craindre d'une comparaison avec les plus beaux échantillons d'aucune nation.

Plus tard, je suis allé au Conservatoire des Arts et Métiers une seconde fois, pour examiner la belle et précieuse collection des poids et mesures français, exécutée par ordre de ce Gouvernement pour les Etats-Unis, en échange du présent précédemment fait à la France par le Gouvernement américain. Elle était mise à part pour être emballée, et expédiée à Washington. Une inscription placée au-dessus, en lettres d'or, désigna la collection, et rappela sa destination comme un don offert par la France aux Etats-Unis. Alors, ayant sous les yeux cette collection complète des poids et mesures du système métrique décimal, je me suis souvenu des principes scientifiques, exacts et infaillibles, sur lesquels est basé ce système, de sa construction simple, régulière, commode, si parfait dans son ensemble, si harmonieux dans toutes ses parties; et je ne pouvais qu'en témoigner hautement mon admiration, et exprimer les vœux bien sincères que je formais, que le jour ne fût pas éloigné, où toutes les nations civilisées, foulant aux pieds leurs vieux préjugés, et mues par une sage intelligence de leurs propres intérêts et des besoins communs, renonceraient à leurs systèmes vieillis, multiformes, incommodes, discordants, et adopteraient franchement le système métrique de France. Ce système porte un beau cachet de catholicité qui le recommande à l'adoption universelle. Tout en étant ajusté particulièrement à la France, il lui est resté intacte cette universalité essentielle de caractère qui le distingue d'une manière si remarquable. Il s'ajusterait facilement au monde entier. ***Le monde entier devrait l'adopter.*** Ce caractère du système, tel que je l'ai dit, sera clairement démontré par l'explication que je me propose d'en faire dans la suite de cette lettre. Il y a des milliers d'hommes aux Etats-Unis, hommes d'une intelligence distinguée et de connaissances étendues, qui n'ont pas étudié le système métrique, et qui, effrayés par sa nomenclature gréco-latine, et par les difficultés présumées de sa construction scientifique, lui ont refusé le temps, véritablement très-peu important, qu'il faudrait pour le bien comprendre. J'espère, mon cher Monsieur, que, présentées au public, comme elles doivent l'être, sous la protection de votre nom, mes remarques sur ce système trouveront de nombreux lecteurs qui, autrement, n'y auraient pas accordé leur attention. J'espère que nos législateurs à Washington examineront la collection des poids et mesures français, déposée au Patent Office, et puis, qu'ils se demanderont sérieusement comment ils pourraient rendre à notre pays si éminemment commercial, dont ils sont les législateurs, de plus éclatants et durables services, qu'en supprimant le misérable tas de coutumes (je ne puis pas les appeler des systèmes) qui existent aux Etats-Unis, et en inscrivant dans nos statuts, comme loi du pays, le système métrique décimal des poids, mesures et monnaies. Si nous l'adoptons, toutes les autres nations seront obligées de le faire. L'Angleterre elle-même, dont le concours est si désirable, si nécessaire même, nous suivrait de près. Elle ne nous devancera jamais dans cette réforme. Tant que la nation, aujourd'hui la seconde, et qui sera bientôt la première nation commerciale de la terre, reste en arrière, l'Angleterre ne fera point un pas en avant. De grands et évidents avantages, des intérêts impérieux lui ordonnent d'avancer, mais il faudra lui trouver d'au-

versal legislative sanction, of the close common interets that make of one family all the nations of the earth. The idea of a « *Universal Republic*, » when it is not the utopia of a sad delusion, is the argument of wicked men for the overturning of society : but, let the various nations of the earth be once united by this strong, practicable, friendly tie, the common adoption of the same system of weights, measures, and money, and other, more close, more endearing ties would soon be created ; and philanthropy of the most positive and practical and cautious school, would be taught to admit that the *Fraternity of nations* is not « all a dream ! »

Several nations of Europe and America have already adopted the french metrical system of weights and measures. It has become the law in Belgium, Spain, Hollande, Greece, Poland, Lombardy, Sardinia, Modena, and to a great extent in Switzerland. The Zollverein has adjusted upon it the common measures used by the Association. Chili, Columbia and New-Grenada, in South America, have accepted it ; and Mexico, in North America. Several of the above named states have adopted the french currency with the metrical system. Let the United States promptly follow their example ! Progress, progress, unembarrassed by the shackles of prejudice, by the trammels of custom, by the hindrances of laws, should characterise our glorious Republic. We have thrown off the rule of prescriptive king, shall we live the subjects of prescriptive error? If we would have our social, political and civil reforms welcomed readily by other nations, let us accept with alacrity from other nations all improvements which they may offer to us, possessing, like the one in question, the recommendation of plain utility, under the seal of genuine science. Let us welcome *Truth*, no matter from what quarter it may come to us !

Before proceeding to an explanation of the metrical system, let me insert, here, several passages of a letter which you have had the kindness to communicate to me. The letter is addressed to yourself by Silbermann, the able superintendent of the Conservatory of Arts and Trades ; and its insertion will be performing more satisfactorily than I could otherwise hope for, one portion of your own request to myself : for the object of the letter was to acquaint you with the character and extent of the collection which this Government was preparing for presentation to the United States and to apprize you that it was almost ready for delivery. In the commencement of his letter, M. Silbermann thus alludes, in most flattering terms, to the collection of weights and measures presented by the United States to France.

« In testimony of the esteem in which I hold these balances, I cannot say more than that I have used the small one to adjust the platinum kilogramm that has been exhibited at the Great Exhibition in London. It is very delicate

et de plus puissantes raisons. Ces raisons existeraient, et à peu près dans la mesure de contrainte, si les Etats-Unis, avec lesquels les rapports commerciaux de l'Angleterre sont si intimes, si importants et si constamment progressifs, adoptaient, les premiers, le système métrique. L'Angleterre, la France et les Etats-Unis l'ayant adopté, toutes les autres nations, de premier et de second rang, qui ne se sont pas encore ralliées, seraient portées et, en quelque sorte, forcées de l'accepter. Alors, pour la première fois, nous verrons, traduits en faits visibles pour tous, reconnus partout, revêtus de la sanction législative universelle, les grands intérêts communs, intimes, qui constituent, en une seule famille, toutes les nations de la terre. L'idée de la *République universelle*, quand elle n'est pas l'utopie d'une triste illusion, est l'argument dont se serviraient de vils intrigants pour le bouleversement de la société ; mais que les divers peuples du globe se trouvent une fois unis par ce lien pratique, solide, amical, l'adoption par tous d'un seul et même système de poids, mesures et monnaies; d'autres liens, plus intimes encore, ne tarderaient pas à se créer, et la philanthropie, fût-elle de l'école la plus positive, la plus pratique, la moins pressée qui puisse être, serait conduite à admettre que *la fraternité des nations* n'est peut-être pas un rêve, rien qu'un rêve !

Plusieurs nations de l'Europe et de l'Amérique ont déjà adopté ce système. Il fait loi en Belgique, en Espagne, en Hollande, en Grèce, en Pologne, en Lombardie, en Sardaigne et à Modène. Il a été accepté en grande partie par la Suisse ; et le Zollverein a basé ses mesures communes sur le système métrique. Il est en vigueur au Chili, dans la Colombie, et dans la Nouvelle-Grenade, dans l'Amérique du Sud ; et au Mexique, dans l'Amérique du Nord. Que les Etats-Unis ne tardent pas à suivre leur exemple ! Le progrès, le progrès libre et constant, que n'embarrassent ni les chaînes des préjugés, ni les entraves des coutumes, ni les empêchements des lois, devrait être le signe distinctif de notre grande République. Nous avons secoué le joug de roi prescriptif, devons-nous rester les sujets de l'erreur prescriptive ! Si nous voulons que nos réformes politiques, civiles, et sociales, soient bien et facilement accueillies par les autres nations, montrons-nous prêts, de notre côté, à accepter, avec empressement, toutes les améliorations qui nous seront offertes par d'autres nations, et qui se recommanderont, comme celle dont il s'agit, par un caractère d'utilité évidente, sous le sceau de la vraie science. Que la Vérité soit la bienvenue, de quelque côté qu'elle nous vienne !

Mais avant d'expliquer le système métrique français, permettez-moi de citer ici quelques passages d'une lettre que vous avez eu l'obligeance de me communiquer ; cette lettre vous est adressée par M. Silbermann, le savant conservateur du conservatoire des Arts et Métiers. En l'insérant ici je ne ferai qu'accomplir, et plus complétement que je n'aurais pu le faire autrement, vos propres intentions, en me priant de préparer un mémoire pour être annexé à votre rapport : car, le but principal de cette lettre était de vous apprendre de quels objets se composait la collection destinée par ce Gouvernement aux Etats-Unis, et de vous annoncer qu'elle était presque prête pour vous être livrée. Dans le commencement de sa lettre, M. Silbermann parle en ces termes, si flatteurs pour les Etats-Unis, des poids et mesures américains, remis, par votre intermédiaire, au Conservatoire des Arts et Métiers de Paris :

« Je ne puis mieux vous témoigner l'estime que je porte à ces balances, qu'en vous disant que je me suis servi de la petite, pour ajuster le kilogramme en platine qui a figuré à l'Exposition de Londres ; sa sensibilité et sa constance

and especially most constant. I have been able to make all my weighings with the certitude of half a milligramm. The form adopted for those balances is at once severe, convenient, and stamped with that noble coquetry, which is only to be found in instruments made by master hands. These are justly termed instruments of precision. What I have just said with regard to the small balance, I may repeat, with still more propriety, respecting the large one. It is not inferior to the former in precision. In fact, I have tested it with ten kilogramms in each scale, and it promptly marks a difference of one half milligramm between the two weights : that is to say, of one unit in twenty millions. I have been obliged to repeat that experiment several times, in presence of incredulous persons, and always with the same result. What is most gratifying to me in the construction of these balances, is the system adopted in the United States, and which consists in preventing the oscillation of the balance and causing it to cant as soon as the equilibrium is destroyed. Thus, the weighings are operated very rapidly, and, as it has been seen, with as much precision as can be obtained with the most carefully made balances. For my part, I have ever regretted that all our balance-makers have hitherto declined the adoption of this system ; they assign as the reason of their reluctance that, with an oscillating balance, they can replace the small weights by arcs of oscillation, which enable them to estimate much smaller fractions of the milligramm. For my part, I doubt whether it be not possible to arrive at the same precision in both systems ; and in that case, there will be a great gain of time in the system of canting. Moreover, I know from experience what confidence is to be placed in weighings estimated by arcs. In spite of the utmost care, the above mentioned very small arcs are variable ; and, while they flatter us with the hope that we have obtained tenths of milligramms, they cause us to make unwittingly errors of more than one and two milligramms. I have been highly pleased with the form given in the United States to the small weights. The form of polygons, with lines of a convenient size, and having a number of sides expressing the amounts of those weights in units, is a very happy idea which secures from false readings. We need no magnifying-glass to distinguish a pentagon which signifies 5, from a quadrilateral figure which signifies 4, from a triangle or 3, from an angle V the two sides of which are 2, and finally from the single straight line, making the unit. This form will certainly be appreciated in France ; and as for myself, I will do every thing in my power to have it adopted by law instead of the ancient form, which is subject to many errors, known only by those who use it often. I have observed with pleasure, even the hooks lined with buff, to take up the weights without soiling them ; and the pincers, also lined with buff, to handle the Troy weights, have been used by me to take up the platinum kilogramm during its adjustment. I consider all these minute precautions as the genuine stamp of the scrupulous experimentalist. One point more, I allude to the alloy adopted in the United States. I will do my utmost to cause the brass employed in France, in the fabrication of weights and measures, to be of the same standard as that of the United States, and free from all hammering or rehardening whatsoever : simply cast, and as uniformly as possible, so as to have the least difference in the density and dilatation of materials, according to their use. This necessity has for a long time been felt, but it has not yet been sanctioned by law, as has been done with respect to the alloy of tin and lead, which forms the measures for liquids, for the verification

sont à l'abri de tout reproche ; avec elle, j'ai pu faire mes pesées avec la certitude du demi-milligramme.

« La forme adoptée pour ces balances est à la fois sévère, bien appropriée à l'usage, et empreinte de cette noble coquetterie qui ne se rencontre que dans les instruments sortis des mains de maître. Ce sont ce qu'on appelle, à juste titre, des instruments de précision.

« Ce que je viens de dire de la petite balance est également vrai, et avec plus de raison encore pour la grande. Avec 10 kilogrammes dans chaque bassin, cette dernière accuse avec facilité un demi-milligramme de différence entre les deux charges, c'est-à-dire une unité sur vingt millions. Cette épreuve a été répétée un grand nombre de fois, autant pour mon édification personnelle que pour convaincre les incrédules.

« Ce qui me plaît le mieux dans ces balances, c'est le système sur lequel leur construction est basée, et qui consiste non plus à faire osciller le fléau comme dans nos balances ordinaires, mais à le faire chavirer immédiatement dès que la charge n'est pas en équilibre. De cette manière, les pesées se font très-rapidement et avec toute la précision qu'on peut donner aux balances les mieux soignées. En ce qui me concerne, j'ai toujours regretté que nos balanciers se soient refusés à adopter ce système. Ils motivent leurs refus en disant qu'avec une balance oscillante on peut remplacer les petits poids par des arcs d'oscillation qui permettent d'estimer de bien plus petites fractions de milligramme. Je ne doute nullement qu'on ne puisse arriver à la même précision dans les deux systèmes : et on réalisera, dès lors, un immense bénéfice de temps avec le système du chavirement. Au reste, je connais par expérience le degré de certitude qu'on peut fonder sur les estimations faites par les arcs ; malgré les soins les plus minutieux, les très-petits arcs, dont il est ici question, sont variables, et tout en vous laissant croire à des dixièmes de milligramme, il vous font commettre à votre insu des erreurs de plus de 2 milligrammes.

« Je vous dirai que j'ai été très-satisfait de la forme qu'on donne en Amérique aux petits poids. Figurer des polygones avec des fils de grosseur convenable, et ayant un nombre de côtés égal au chiffre que ces poids expriment, est une idée très-heureuse, qui protége contre les fausses lectures ; pas n'est besoin de loupe pour distinguer un pentagone, qui signifie 5, d'un angle V, dont les deux côtés indiquent 2, et enfin du fil droit, unique, servant d'unité. C'est un mode qui sera certainement apprécié en France, et que, de mon côté, je chercherai à rendre légal, en le substituant à la forme adoptée, et qui est sujette à des erreurs, connues seulement des personnes qui en font souvent usage.

« J'ai vu avec plaisir les crochets garnis de peau de buffle, afin d'enlever les poids, sans les frayer. La pince, pareillement garnie de buffle et destinée à saisir les poids Troy, m'a servi à saisir le kilogramme en platine pendant son ajustement ; toutes ces petites précautions constituent à mes yeux le véritable cachet de l'expérimentateur scrupuleux.

« Quant à la justesse des poids et des mesures, ce que je vois m'en est un sûr garant.

« Un autre point à noter est l'alliage adopté aux Etats-Unis. Je prônerai cet alliage le plus haut possible, pour que le laiton employé en France à la confection des poids et des mesures, soit de même titre que celui des Etats-Unis. Avec le secours de cet alliage, on peut viser à obtenir des mesures et des poids exempts de martelage et d'écrouissage ; on se borne à couler les

of which has even been created an hydrostatical balance, as you will perceive in the list of french articles which will be presented to you. »

Mr. Silbermann then proceeds thus to describe the collection which has been forwarded to Washington.

« The weights and measures, with their accompanying apparatus, that the Government of the French Republic puts at your disposal, to be presented in its name to the Government of the United States, as a token of reciprocal sympathy, are the following, viz :

«1st A complete collection of the whole apparatus, weights, and measures, composing in France the bureau of verification of weights and measures, to wit :

Measures of length.

1 Brass metre, graduated throughout its whole length. Used as a standard;
1 Wooden metre, ironed at both ends;
1 Double decimetre;
1 Decametre (surveyor's chain) with 10 stakes;
1 Chain-metre for measuring the circumference of fagots, and bundles of firewood.

Measures of capacity.

BRASS STANDARDS, WITH DISKS OF GROUND GLASS.

	Litres.
1 Double decalitre.....	20
1 Decalitre.....	10
1 Demi-decalitre.....	5
1 Double litre.....	2
1 Litre.....	1
1 Demi-litre.....	0.5

	Litres.
1 Double decilitre.....	0.2
1 Decilitre.....	0.1
1 Demi-Decilitre.....	0.05
1 Double-centilitre.....	0.02
1 Centilitre.....	0 01

pièces le plus uniformément possible, afin de n'avoir, dès le principe, qu'une différence minimum dans les dilatations ou densités des matières.

« Cette nécessité est depuis longtemps sentie, mais elle n'a pas encore été sanctionnée par la loi, comme l'a été l'alliage d'étain et de plomb qui forme les mesures de capacité pour les liquides, et pour la vérification duquel on a même spécialement construit une balance hydrostatique, comme vous le verrez dans la nomenclature des objets qui vous seront soumis. »

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Puis, M. Silbermann donne, ainsi qu'il suit, l'énumération de ces objets qui aujourd'hui font l'ornement du Patent-Office, à Washington :

« Les poids et mesures, ainsi que les instruments de pesage, de mesurage et de poinçonnage que le Gouvernement de la République Française met à votre disposition pour être remis en son nom au Gouvernement de la République de l'Union américaine, comme gage de sympathie réciproque, sont les suivants :

« 1° Une collection complète de tous les appareils, poids et mesures, qui composent en France les bureaux de vérificateur des poids et mesures, et dont les détails sont :

Mesures de longueur.

1 mètre en laiton, divisé dans toute sa longueur, servant d'étalon.
1 mètre en bois, ferré aux deux bouts.
1 double décimètre.
1 décamètre (chaîne d'arpenteur) avec dix fiches.
1 mètre chaîne pour mesurer le pourtour des fagots et falourdes.

Mesures de capacité.

ÉTALONS EN LAITON, AVEC DISQUES DE GLACE DÉPOLIE.

	Litres.		Litres.
1 Double décalitre.....	20	1 Double décilitre.....	0.2
1 Décalitre.....	10	1 Décilitre.....	0.1
1 Demi-décalitre.....	5	1 Demi-décilitre.....	0.05
1 Double litre.....	2	1 Double centilitre.....	0.02
1 Litre.....	1	1 Centilitre.....	0.01
1 Demi-litre.....	0.5		

SPECIMENS, IN LEGAL FORM, OF PEWTER MEASURES OF CAPACITY, IN USE FOR LIQUIDS.

1st Series (cylindrical).		*2nd Series (with handle).*		*3d Series (with handle and cover)*	
	Litres.		Litres.		Litres.
1 Double litre	2	1 Double litre	2	1 Double litre	2
1 Litre	1	1 Litre	1	1 Litre	1
1 Demi-litre	0.5	1 Demi-litre	0.5	1 Demi-litre	0.5
1 Double decilitre	0.2	1 Double decilitre	0.2	1 Double decilitre	0.2
1 Decilitre	0.1	1 Decilitre	0.1	1 Decilitre	0.1
1 Demi-decilitre	0.05	1 Demi-decilitre	0.05	1 Demi-decilitre	0.05
1 Double centilitre	0.02	1 Double centilitre	0.02	1 Double centilitre	0.02
1 Centilitre	0.01	1 Centilitre	0.01	1 Centilitre	0.01

SPECIMENS IN TIN-PLATE OF MEASURES OF CAPACITY, — FOR MILK, AND OIL.

1st Series.

For milk, and military rations.

1 Double litre.	1 Double decilitre.	1 Double centilitre.
1 Litre.	1 Decilitre.	1 Centilitre.
1 Demi-litre.	1 Demi-decilitre.	

2nd Series.

For lamp-oil. — Marked B.

1 Double litre.	1 Double décilitre.	1 Double centilitre.
1 Litre.	1 Decilitre.	1 Centilitre.
1 Demi-litre.	1 Demi-Decilitre.	

3d Series.

For table-oil. — Marked M.

1 Double litre.	1 Double decilitre.	1 Double centilitre.
1 Litre.	1 Decilitre.	1 Centilitre.
1 Demi-litre.	1 Demi-decilitre.	

SPECIMENS, IN WOOD, OF MEASURES OF CAPACITY, — FOR GRAINS.

	Litres.		Litre.
1 Hectolitre	100	1 Litre	1
1 Demi-hectolitre	50	1 Demi-litre	0.5
1 Double decalitre	20	1 Double decilitre	0.2
1 Decalitre	10	1 Decilitre	0.1
1 Demi-decalitre	5	1 Demi-decilitre	0.05
1 Double litre	2		

SPECIMENS, IN WOOD, OF MEASURES OF CAPACITY. — FOR COAL (WITH FEET).

	Litres.		Litres.
1 Hectolitre	100	1 Demi-litre	50

ÉCHANTILLONS DE FORME LÉGALE DES MESURES DE CAPACITÉ EN ÉTAIN EN USAGE POUR LES LIQUIDES.

1re *Série* (*cylindriques*).		2e *Série* (*avec anse*).		3e *Série* (*avec anse et couvercle*).	
	Litres.		Litres.		Litres.
1 Double litre. . . .	2	1 Double litre. . . .	2	1 Double litre. . . .	2
1 Litre.	1	1 Litre.	1	1 Litre.	1
1 Demi-litre.	0.5	1 Demi-litre.	0.5	1 Demi-litre.	0.5
1 Double décilitre.	0.2	1 Double décilitre.	0.2	1 Double décilitre.	0.2
1 Décilitre.	0.1	1 Décilitre, ...	0.1	1 Décilitre.	0.1
1 Demi-décilitre. .	0.05	1 Demi-décilitre. .	0.05	1 Demi-décilitre. .	0.05
1 Double centilitre	0.02	1 Double centilitre	0.02	1 Double centilitre	0.02
1 Centilitre.	0.01	1 Centilitre.	0.01	1 Centilitre.	0.01

ÉCHANTILLONS DES MESURES DE CAPACITÉ EN FER-BLANC POUR LE LAIT ET L'HUILE.

1re *Série.*

Pour le lait et les rations militaires.

1 Double litre.	1 Double décilitre.	1 Double centilitre.
1 Litre.	1 Décilitre.	1 Centilitre.
1 Demi-litre.	1 Demi-décilitre.	

2e *Série.*

Pour l'huile à brûler, marquées B.

1 Double litre.	1 Double décilitre.	1 Double centilitre.
1 Litre.	1 Décilitre.	1 Centilitre.
1 Demi-litre.	1 Demi-décilitre.	

3e *Série.*

Pour l'huile à manger, marquées M.

1 Double litre.	1 Double décilitre.	1 Double centilitre.
1 Litre.	1 Décilitre.	1 Centilitre.
1 Demi-litre.	1 Demi-décilitre.	

ÉCHANTILLONS DES MESURES DE CAPACITÉ EN BOIS POUR LES MATIÈRES SÈCHES, POUR LES CÉRÉALES, ETC.

	Litres.		Litre.
1 Hectolitre.	100	1 Litre.	1
1 Demi-hectolitre.	50	1 Demi-litre.	0.5
1 Double décalitre.	20	1 Double décilitre.	0.2
1 Décalitre.	10	1 Décilitre.	0.1
1 Demi-décalitre.	5	1 Demi-décilitre.	0.05
1 Double litre.	2		

ÉCHANTILLONS DES MESURES DE CAPACITÉ EN BOIS POUR LE CHARBON (MESURES AVEC PIEDS).

	Litres.		Litres.
1 Hectolitre.	100	1 Demi-hectolitre.	50

Weights.

BRASS STANDARDS (WITH KNOBS).

	Grammes.		Grammes.
1 Weight of 20 kilog..	20,000	2 Double grammes.....	2
1 — of 10 — ..	10,000	1 Gramme.....	1
1 — of 5 — ..	5,000	1 Of five decigrammes...	0.5
1 Double kilogramm...	2,000	1 Of two decigrammes...	0.2
2 Of one kilogramm...	1,000	2 Of one decigramm....	0.1
1 Demi-kilogramm....	500	1 Of five centigrammes..	0.05
1 Double hectogramm..	200	1 Of two centigrammes..	0.02
2 Of one hectogramm..	100	2 Of one centigramm...	0.01
1 Demi-hectogramm...	50	1 Of five milligrammes..	0.005
1 Double decagramm..	20	2 Of two milligrammes..	0.002
2 Of one decagramm...	10	1 Milligramm.....	0.001
1 Demi-decagramm....	5		

CUP-WEIGHTS (*à godets*).

Cup-weights forming together 1 *kilogramm — and divided into weights of*

500 Grammes.	100 Grammes.	10 Grammes.	2 Grammes.
200 —	50 —	10 —	2 —
100 —	20 —	5 —	1 —

CAST-IRON WEIGHTS (OF TRAPEZOIDAL FORM).

1 Of 50 kilogrammes.	1 Of 20 kilogrammes.

CAST-IRON WEIGHTS (OF PYRAMIDAL FORM).

10 Kilogrammes.	500 Grammes.
5 —	200 —
2 —	100 —
1 —	50 —

«The apparatus of verification consists of :

1 Balance carrying 50 kilogrammes : the beam turns with 0.02 gramm.
1 ——— 1 kilogramm : ——— 0.01 —
1 Test-balance carrying 20 grammes: ——— 0.001 —
1 Hydrostatic balance carrying 2 kilogrammes : the beam turning with 0.1 gramm.

«The test-balance for the verification of the small weights contains two series of weights of 20 grammes, 10 gr., 10 gr., 2 gr., 2 gr., 1 gr. ; also a series of the subdivisions of the gramm : and also two supernumerary plates.

Poids.

ÉTALONS EN LAITON, A BOUTONS.

	Grammes.		Grammes.
1 Poids de 20 kilogr....	20,000	2 Doubles grammes....	2
1 — de 10 —	10,000	1 Gramme.....	1
1 — de 5 —	5,000	1 Cinq décigrammes....	0.5
1 Double kilogramme..	2,000	1 Deux décigrammes...	0.2
2 Un kilogramme.....	1,000	2 Un décigramme.....	0.1
1 Demi-kilogramme....	500	1 Cinq centigrammes...	0.05
1 Double hectogramme.	200	1 Deux centigrammes...	0.02
2 Un hectogramme....	100	2 Un centigramme.....	0.01
1 Demi-hectogramme..	50	1 Cinq milligrammes....	0.005
1 Double décagramme..	20	2 Deux milligrammes...	0.002
2 Un décagramme.....	10	1 Milligramme.....	0.001
1 Demi-décagramme...	5		

POIDS A GODETS.

Composant ensemble 1 kilogramme, et se détaillant en :

500 Grammes.	100 Grammes.	10 Grammes.	2 Grammes.
200 —	50 —	10 —	2 —
100 —	20 —	5 —	1 —

POIDS EN FONTE DE FORME TRAPÉZOÏDALE.

1 de 50 Kilogrammes.	1 de 20 Kilogrammes.

POIDS EN FONTE DE FORME PYRAMIDALE.

10 Kilogrammes.	500 Grammes.
5 —	200 —
2 —	100 —
1 —	50 —

« Les appareils de vérification sont :

1 Balance de la portée de 50 kilogrammes trébuchant à... 0.02 gr.
1 ——— de 1 kilogramme — à... 0.01 —
1 Balance d'essai de la portée de 20 grammes trébuchant à. 0.001 —
1 — hydrostatique de la portée de 2 kilog. trébuchant à 0.01 —

« La balance d'essai pour la vérification des petits poids contient deux séries de poids de 20 gr., 10 gr., 10 gr., 5 gr., 2 gr. et 1 gr., plus une série du gramme subdivisé, et enfin deux plateaux de rechange.

The hydrostical balance is accompanied with a copper bucket, to operate weighings in water. This balance serves in the verifying process to determine the standard of the alloy employed in the fabrication of the pewter measures of capacity.

«A *hopper*, fixed upon an oaken board, is used for the verification of the wooden measures of capacity.

«A *strike* is added to remove the surplus of the seeds, gauged in advance, which are employed in this process.

«For this purpose we use rape-seeds, or any other seeds of small round and regular form.

«Upon the oaken board is fastened a screw-press, intended to affix a stamp to the measures. For this purpose it is accompanied by a beak-iron, and two cushions, as also by two keys to tighten the screw-nuts.

«The verifiers who, in their rounds of inspection, could not carry along with them the cumbersome apparatus described above, are merely provided with a small case, containing the following articles, which you will find in the *verifiers' box.*

1 Wooden metre, divided into two parts;
1 Double decimetre made of box-wood;
1 Copper gauge, with projecting divisions for the verification of the dimensions of wooden measures of capacity; from the double hectolitre down to the demi-decilitre;
1 Balance (double system), used as a roman balance, at $^1/_{10}$, for weights of from 2 to 20 kilogramms; and as an equal-arm balance, for the kilogramm and its subdivisions;
1 Iron press, for stamping;
1 Sledge-hammer;
7 Samples of stamps;
1 Cup-kilogramm (*à godets*); similar to that mentioned above;
1 kilogramm, with knobs.

«To the above articles has been joined the official publication of the ordinances and instructions concerning the fabrication and verification of weights and measures, accompanied by an atlas which represents them in their legal form.

«2*nd* To the above collection, of which the object is not great precision, but a precision sufficient for ordinary use, has been added a set of units, the perfect exactness of which is guarantied by the name of their maker *Gambey.* These units are :

1 Brass graduated metre;
1 — litre;
1 — kilogramm (gilded).

«3*d* Finally, to crown this donation, the minister of commerce has caused to be added to it *a standard-metre*, in the construction of which I am at present occupied, and which will be most carefully compared with the *platinum prototype-metre* which is deposited among the Archives of the State.

La balance hydrostatique est accompagné d'un seau en cuivre pour faire les pesées dans l'eau.

« Cette balance sert, dans la vérification, à déterminer le titre de l'alliage employé pour la confection des mesures de capacité en étain.

« Une trémie, se fixant à un établi en chêne, qui lui sert de support, est destinée à vérifier les mesures de capacité en bois ; une racloire sert à enlever le trop plein de la graine jaugée à l'avance, qui est affectée à ces mesurages.

« La graine employée dans ce cas est celle de navette, ou toute autre, dont la forme est ronde, petite et régulière.

« Sur cet établi, se fixe une presse à vis destinée à poinçonner les mesures ; à cette fin, elle est accompagnée d'une boîte contenant une bigorne et deux coussinets, ainsi que de deux clefs pour serrer les écrous.

« Les vérificateurs qui, dans leurs tournées d'inspection, ne pourraient traîner à leur suite le lourd attirail qui précède, sont simplement munis du petit nécessaire contenant les objets suivants, que vous trouverez dans la boîte dite de vérificateur :

1 Mètre en bois en deux parties ;
1 Double décimètre en buis ;
1 Jauge en cuivre, avec divisions saillantes, pour la vérification de la dimension des mesures de capacité en bois, depuis le double hectolitre jusqu'au demi-décilitre ;
1 Balance à double système servant de romaine à $^1/_{10}$, pour les poids de 20 à 2 kilogrammes, et de balance à bras égaux pour le kilogramme et ses divisions ;
1 Presse en fer pour le poinçonnage ;
1 Marteau masse ;
7 Modèles de poinçons ;
1 kilogramme à godets, pareil à celui déjà indiqué ;
1 kilogramme à bouton.

« A tous ces objets, on a joint le Recueil officiel des ordonnances et instructions sur la fabrication et la vérification des poids et mesures, accompagné de l'Atlas qui les représente dans leur forme légale.

« 2° A cette collection, dont le but n'est pas la grande précision, mais bien celle pratiquée dans les usages civils, il a été ajouté un groupe d'unités dont la parfaite exactitude est garantie par le nom de son exécuteur, Gambey.

Ces unités sont :

1 Mètre en laiton divisé ;
1 Litre —
1 Kilogramme en laiton divisé doré.

« 3° Enfin, pour couronner cette offrande, M. le ministre du commerce a fait ajouter un mètre type, que je fais construire en ce moment, et qui sera comparé, avec le plus grand soin, avec le mètre prototype en platine, déposé aux Archives de l'Etat.

«This metre will be *à bout* and *à trait*. By means of a second rule to which it will be fastened, at one end, it will form a *borda-thermometer*. By this addition, the absolute length of the metre, and its temperature, at any moment, will be perceived. These two rules will necessarily be made of two different metals. The metre will be of steel, and the other which supports it, will be of bronze. The difference of dilatation between these two metals is great enough to give appreciable divisions on the two corresponding scales, drawn near the free ends of the two rules. I will give you the details of the construction of this standard metre, when I shall send you the results of my experiments upon the dilatation of the two metals and of the comparison of this metre with its prototype. I am also about to verify the brass weights, and the measures of capacity. So soon as all shall be accomplished, the whole shall be forwarded to you in good order. »

The system of weights and measures, of which we possess, according to the above enumeration, complete specimens of all the component instruments and utensils, is called the ***metrical decimal system : metrical***, because it is founded upon and derived from the ***metre***, unit of measures of length ; ***decimal***, because, in all the multiples and divisions of the metre, and of the other units of the system, it is proceeded by ***decimals*** or ***tens*** : thus, tens, hundreds, thousands, tens of thousands ; and tenths, hundredths, thousandths, etc.

But the *metre* itself, the unit of measures of length, or of lineal measures, the measure analagous to our ***yard*** (which it a little exceeds in length), the base of the whole system, what is it? and how was it obtained?

Here is the history of the *metre*.

The metrical system was one of the earliest productions of the first revolution. Prior to 1789, France was divided into numerous large provinces, which formerly had been so many independent dukedoms and principalities. All these had long been united to form the one great French monarchy. But the union had been effected gradually, at different epochs, and upon different conditions. Each province, long after its independent political existence had ceased, merged, by virtue of conquest, or marriage alliance, or treaty, in the overshadowing monarchy, retained its peculiar laws, customs and privileges. Thus, Brittany, Picardy, Normandy, Champagne, Guienne, Burgundy, Provence, Languedoc, Anjou, and numerous other territorial divisions, arrived at the revolution of 1789, each with its peculiar system of weights and measures. The result was such a perpetual and intolerable confusion of ideas, and collision of interests, that one of the earliest cares of the ***Constituent Assembly*** was to provide for this crying evil a prompt remedy. Radical reformation of the weights and measures of France was resolved on. In 1790, in the midst of its eventful political transformations, the Assembly, upon the motion of ***Talleyrand***, one of its members, charged the Academy of Sciences to devise a system, which, founded upon unalterables principles, upon the laws of Nature, should establish order and uniformity, in place of the chaos which prevailed in France, and be at the same time of a character to admit of extension over all the nations of the earth. The Academy addressed itself seriously and intelligently to its work. It resolved that the unit of lineal measures should be the basis of the new system; that this unit should be called

« Ce mètre sera à bout et à trait ; il constituera un thermomètre de Borda, au moyen d'une seconde règle sur laquelle il sera fixé par l'une de ses extrémités. Par cette addition, on aura à chaque instant, soit la longueur absolue du mètre, soit sa température.

« Les deux règles seront nécessairement de deux métaux différents : le mètre sera en acier, et l'autre, qui le supporte, sera en bronze ; la différence dans la dilatation de ces deux métaux est assez grande pour donner des divisions appréciables sur les deux échelles correspondantes, tracées vers les extrémités libres de ces deux règles.

« Je vous marquerai les détails de construction de ce mètre-type, lorsque je vous adresserai le résultat de mes expériences sur la dilatation des deux métaux, ainsi que ceux de sa comparaison.

« Je me dispose aussi à vérifier les poids en laiton et les mesures de capacité. Aussitôt que ces travaux seront terminés, le tout vous sera remis en bon ordre. »

Le système de poids et mesures dont nous possédons, d'après l'énumération ci-dessus, une collection complète de tous les instruments et appareils, se nomme le *système métrique décimal.—Métrique*, parce qu'il est basé sur le *mètre*, l'unité de longueur, duquel dérivent toutes les unités du système ; *décimal*, parce que tous les multiples et divisions du *mètre* et des autres unités se font par *décimales*, de dix en dix : par exemple : dix, cent, mille, dix mille, etc. ; dixième, centième, millième, dix millième, etc.

Mais qu'est-ce que le *mètre* lui-même, l'unité de longueur ou de mesures linéaires, la mesure analogue à notre *yard* (qu'il excède un peu en longueur), la base du système, et comment l'a-t-on obtenu ? Voici l'histoire du *mètre :*

Le système métrique fut l'un des premiers fruits de la première révolution française. Avant 1789, la France se divisait en de nombreuses provinces, qui furent autrefois des duchés et des principautés indépendants. Toutes ces provinces étaient depuis longtemps réunies pour constituer la grande monarchie française. Mais cette réunion s'était effectuée, successivement, à diverses époques et à des conditions différentes ; et chaque province, dont l'existence politique indépendante s'était depuis longtemps éteinte, absorbée, par la monarchie grandissante, en vertu de conquête, de traités, ou de mariages des souverains, gardait ses propres lois, coutumes et priviléges. Ainsi, la Bretagne, la Picardie, la Normandie, la Champagne, la Guienne, la Bourgogne, la Provence, le Languedoc, l'Anjou, etc., arrivaient à la révolution de 1789, chacune avec son système spécial de poids et mesures. Il résultait de cet état de choses une confusion intolérable dans les affaires, et une telle collision d'intérêts, que l'un des premiers soins de l'Assemblée constituante fut de trouver un prompt remède à ce mal criant. La réforme radicale des poids et mesures de France fut résolue. En 1790, au milieu des grands événements politiques qui marquèrent cette époque, l'Assemblée, sur la motion de Talleyrand, l'un de ses membres, ordonna à l'Académie des Sciences de chercher un système, lequel, fondé sur des principes invariables, sur les lois de la nature même, établirait l'ordre et l'uniformité, à la place du chaos qui régnait en France, et serait, en même temps susceptible, par son extension au dehors, de devenir un jour le lien qui unirait toutes les nations de la terre. L'Académie se mit sérieusement et savamment à l'œuvre. Elle résolut que l'unité des mesures de longueur serait

metre (from the greek μετρον, measure) ; and further that the length of the metre should be *the ten millionth part of a quadrant of the earths' meridian* : that is to say the ten millionth part of the distance from the equator to the pole ; or onelink of a chain of 40 millions equal links, that would extend entirely around our globe, passing over the poles. They adopted, 30 april 1799, a provisional *metre*, the length of which was deduced from the measurement of the meridian, made some forty years previously, in Peru, by the distinguished french geometer *Caille* or *Lacaille*. For greater certainty, however, a new trigonometrical measurement of the meridian, viz of that passing through France, from Barcelona to Dunkirk, and capable of prolongation, North, from the isle de Wight, through England and Scotland, was ordered and effected. The northern portion was confided to *Roy*, *Mechain* and *Delambre*, while *MM. Biot* and *François Arago*, the illustrious astronomer whom France and science have just lost, prolonged the meridian toward the South, through Spain, to Formentera, one of the Balearic islands, in the Mediterranean sea, on the eastern coast of Spain. These french geometers were aided by the spanish commissioners Chaix and Rodriguez. It was his able cooperation in this work, during the years 1806 and 1807, that won for Arago admission, at the early age of twenty three, into the Academy of Sciences of Paris, as successor of the illustrious Lalande. Every subsequent year of Arago's life heaped proof upon proof that this signal honour was not misplaced. From this measurement was deduced the definitive and actual *metre*. « That meridian was selected», says Mr Silbermann, « not because it was in France, but because it was, in Europe, the longest arc of a meridian the two extremities of which would rest upon the level of the sea, and within convenient distance of France. » Mr Silbermann affords me the following interesting historical passage relative to the scientific labours which resulted in the production of the *metre*.

« That gigantic work, accomplished in the whirl of the revolutionary storm, was not to be achieved as the selfish work of France alone. Such was not the will of the french people. The government of that day invited foreign nations to cooperate in the definitive work, by the formation of a congress composed of the most eminent learned men of each country.

The commission of weights and measures was composed of

Missrs Anae, of the Batavian Republic.
de Balbe, of Sardinia.
Berthollet, of France.
Borda, —
Brisson, —
Coulomb —
Darcet, —
Delambre, —
Bugge, of Denmark.
Ciscar, of Spain.
Fabrony, of Toscany.
Franchini, of the Roman Republic.

la base du nouveau système, — que cette unité se nommerait *mètre* (du grec μετρον, *mesure*), — et, de plus, que la longueur du mètre serait *la dix millionième partie du quart du méridien terrestre* : c'est-à-dire la dix millionième partie de la distance comprise entre le pôle boréal et l'Equateur; ou un anneau d'une chaîne, se composant de 40 millions d'anneaux égaux, qui s'étendrait autour de notre globe, en passant sur les pôles. L'on adopta, le 30 avril 1799, *un mètre provisoire*, déduit de la mesure de l'arc méridien que, quarante ans auparavant, au Pérou, le géomètre français, *Caille* ou *Lacaille* avait déterminé. Cependant, pour plus de sûreté, des géomètres distingués furent chargés de mesurer spécialement un autre méridien, — c'est-à-dire celui passant par la France, de Barcelone à Dunkerque, et qu'on pourrait prolonger au Nord de l'île de Wight, à travers l'Angleterre et l'Ecosse. Ce travail, pour la partie septentrionale du méridien, fut confié à Roy, Méchain et Delambre; tandis que Biot et François Arago, l'illustre astronome, que la France et la science viennent de perdre, prolongèrent ce méridien au Sud, à travers l'Espagne, jusqu'à Formentera, l'une des Baléares, îles de la Méditerranée, non loin des côtes orientales de l'Espagne. MM. Chaix et Rodriguez, commissaires espagnols, prêtèrent aux géomètres français le concours de leurs lumières et de leur zèle. Ce fut sa coopération éclairée et persévérante dans ces travaux scientifiques, pendant les années 1806 et 1807, qui ouvrit à Arago, à l'âge de 23 ans, les portes de l'Académie des Sciences de Paris, comme successeur de l'illustre Lalande; et à partir de cette époque, à chaque pas dans sa carrière scientifique, Arago ne cessa de donner des preuves, de plus en plus convaincantes, que cet honneur signalé n'était pas mal placé. Ce fut de ce méridien, dont la longueur était ainsi déterminée, que l'on a déduit le *mètre* définitif actuel. « Ce méridien n'a pas été choisi, dit M. Silbermann, parce qu'il traversait la France, mais bien parce qu'en Europe c'était le plus long méridien qu'on pût choisir à proximité de la France, et qui pût appuyer ses deux extrémités sur le niveau des mers. » M. Silbermann me fournit un passage historique intéressant relatif à ces travaux scientifiques qui nous donnèrent le *mètre*.

« Exécuté au plus fort de la tourmente révolutionnaire, ce travail gigantesque ne devait pas être l'œuvre égoïste de la France, et telle n'était pas la volonté du peuple français. Le Gouvernement d'alors invita les puissances étrangères à coopérer au travail définitif, en instituant un congrès universel, composé des savants les plus illustres de chaque pays.

Cette commission des poids et mesures fut composée de

MM. Anae, envoyé par la République batave,
de Balbe, envoyé par la Sardaigne.
Berthollet, membre de l'Institut de France et d'Egypte.
Borda, — —
Brisson, — —
Coulomb, membre de l'Institut de France.
Darcet, — —
Delambre, — —
Bugge, envoyé par le Danemark.
Ciscar, envoyé par l'Espagne.
Fabroni, envoyé par la Toscane.
Franchini, envoyé par la République romaine.

Haüy, of France.
Lagrange, —
Laplace —
Lefebvre-Gineau, —
Legendre, —
Mascheroni, of the Cisalpine Republic.
Mechain, of France.
Monge, —
Multedo, of the Ligurian Republic.
Pedrages, —
Prony, of France.
Tralles, of the Swiss Republic.
Van-Swinden, of the Batavian Republic.
Vandermonde, of France.
Vassali, of Piedmont.
Lenoir, of France.
Fortin, —

« Lavoisier, Tillet, and General Meunier took also an active part in the work; but unhappily their cooporation was of short duration.

« That illustrious commission took into consideration the works already accomplished, tested them, discussed them, and deduced from them the new system, thanks to the untiring zeal of several of its members, such as Tralles and Lefebvre-Gineau, who undertook the performance of the experiments of precision. It was Lenoir, a french artist, who made the *metre*, and the apparatus relating to it. Fortin, a french artist also, made the *kilogramm* and its apparatus.

« *Tralles*, as reporter of the Commission, presented the platinum prototypes, first to the Institute of France, and afterwards to the Legislative Body. It is thus, that beneath the aegis of this most illustrious commission, and by the unwavering will of the Legislative Body, the new system of weights and measures was substituted in place of the old : endowing the world with units, which may be accepted by all civilized nations.»

The original *provisional metre*, deduced from the old measurement by *Lacaille*, in Peru, was, to the great honour of that geometer, almost inappreciably different in length from that definitively adopted, after the great special trigonometrical measurement of the meridian above described. For all practical and commercial purposes, for all purposes not purely scientific and theoretical, it is the same. The length of the definitive or legal *metre* is about 3 *feet* 3 1/3 *inches* our measure; or 39.370091 *inches* of the *british imperial yard*, exactly.

And now, before proceeding to explain the metrical system, let me establish here, as its faithful historian, a fact touching this last trigonometrical measurement of the Meridian,—that of 1806 and 1807,—from which the definitive *metre* now recognized, was deduced. All scientific men admit that there was error in that measurement, — that it was not exact, — and therefore, that

Haüy, membre de l'Institut de France.
Lagrange, — —
Laplace, — —
Lefebvre-Gineau, — —
Legendre, — —
Mascheroni, envoyé par la République Cisalpine.
Méchain, membre de l'Institut de France.
Monge, membre de l'Institut de France et d'Egypte.
Multédo, envoyé par la République ligurienne.
Pedrayès, envoyé par l'Espagne.
Prony, membre de l'Institut de France.
Trallès, envoyé par la République Helvétique.
Van-Swinden, envoyé de la République Batave.
Vandermonde, membre de l'Institut de France.
Vassali, envoyé par le Piémont.
Lenoir, artiste français qui a exécuté le mètre et les appareils y relatifs.
Fortin, artiste français qui a exécuté le kilogramme et les appareils y relatifs.

« Ont encore pris part directe à cette œuvre, quoique malheureusement leur concours n'ait eu que peu de durée, Lavoisier, puis Tillet et le général Meunier.

« Cette illustre Commission reçut communication des travaux déjà faits, les vérifia, les commenta, et en déduisit le système nouveau, grâce aux soins infatigables de quelques-uns de ses membres, tels que Trallès et Lefèvre-Gineau, qui se chargèrent des travaux de précision.

« Trallès, en sa qualité de rapporteur de la commission, après les avoir présentés à l'Institut de France, présenta les prototypes en platine au Corps législatif.

« C'est ainsi que, sous l'égide de la Commission la plus illustre et sous la volonté du Corps législatif, le nouveau système des poids et mesures remplaça les vieux errements et dota le monde d'unités acceptables pour toutes les nations civilisées. »

Au grand honneur de ce savant, le premier mètre provisoire, déduit de la mesure de l'arc du méridien déterminé par *Lacaille*, au Pérou, différa d'une quantité presqu'inappréciable du mètre définitivemcnt adopté, d'après le méridien, mesuré spécialement à cet effet, dont nous avons parlé ci-dessus. Pour tous les besoins pratiques et commerciaux, pour tous les besoins qui ne sont pas purement scientifiques et théoriques, les deux mètres ne font qu'un. La longueur du mètre définitif, légal, est d'environ 3 *feet* 3 1/3 *inches* des mesures américaines, ou 39,370091 *inches* du *yard* impérial de la Grande-Bretagne, exactement.

Et maintenant, avant d'expliquer le système métrique, je dois, en historien fidèle, constater un fait relatif aux opérations trigonométriques faites en 1806 et 1807, qui nous ont donné le mètre définitif. Tous les savants reconnaissent aujourd'hui qu'il y avait erreur dans ces opérations, — que la mesure trouvée pour le méridien n'était pas scrupuleusement exacte, — et, en consé-

while the *metre* deduced from it is more near to absolute truth than the former *provisional metre*, deduced from Lacaille's measurement, yet it is itself imperfect, being a *little two short*. The provisional metre was $443\frac{440}{1000}$ lines in length. The actual or *legal metre* is $443\frac{296}{1000}$ lines in length. According to Delambre, this is $\frac{32}{1000}$ of a line, or perhaps only $\frac{26}{1000}$ of a line, too little. *Puissant* thought this error slightly greater. All these differences are inappreciable, except for rigorously theoretical purposes. Mechain himself acknowledged afterwards, what he concealed from the commission, that the latitude which he found for Barcelona, in the measurement of 1806-7, was not very certain.

431 Jth.

1454 Jth.

According to *Bessel* (Astr. Nachr. 1842), the distance from the equator to the pole contains 10,000,855 metres (6214 miles + [redacted] yards). According to *Puissant*, that distance contains 10,001,290 metres. According to *Chazallon* that distance contains 10,001,790 metres (in our measure 6214 miles + [redacted] yards). Thus, the distance of 10,000,000 metres, established in 1806-7, as the distance from the equator to the pole, is too small by 935 yards, according to Bessel; by 1410 yards according to Puissant; and by 1958 yards according to Chazallon. The great trigonometrical surveys in India (1832-42) afford slightly varying results; but, I again repeat that pratically these differences amount to nothing when applied to the *metre* as the unit of long measure, for commercial purposes.

We have thus obtained the *metre*, unit of long or lineal measure, the base upon which the metrical system is built.

Now for its multiples and divisions.

The nomenclature which has been invented for the new system is ingenious, convenient and learned. It is the latter quality, probably, which, causing groundless apprehensions of the difficulty of the task, induces most persons to refuse the little time that is really necessary for the clear comprehension of the system.

The nomenclature is, in fact, simple, easily understood, easily remembered by all, and by those who have the silghtest pretention to classical learning, it is understood, and remembered, from its first announcement, without the slightest effort. The nomenclature has, besides, the cardinal merit of being suggestive of the thing signified. *The name instantly suggests the amount, and the nature of the measure.* One has but to fix in his memory, *twelve* short words, with their meaning, and the difficulty is mastered. It is the simple, natural, and systematic combination of these twelve words, that makes up the whole nomenclature of the system. These words are no more french than they are english; and it is no less and no more difficult for a Frenchman to learn them, than it is for any foreigner. They are appropriate, therefore, for universal adoption.

These twelve words are, in the first place, *four* of the ascending series, expressing the *multiples*, or augmentations of the metre and other units. These are all derived from the *Greek*. They are :

Deca	signifying	ten.
Hecto	—	hundred.
Kilo	—	thousand.
Myria	—	ten thousand.

quence, que le *mètre* qui en est déduit, tout en approchant de la vérité absolue plus près que le premier mètre provisoire, ne l'atteint pas tout à fait. Il est *un peu trop court*. La longueur du mètre provisoire était de $443\ \frac{440}{1000}$ lignes. Celle du *mètre définitif, légal*, est de $443\ \frac{296}{1000}$ lignes. Cette longueur, selon *Delambre*, serait trop courte de $\frac{32}{1000}$ d'une ligne ou peut-être de $\frac{26}{1000}$ d'une ligne seulement ; et, selon *Puissant*, d'un peu plus. Toutes ces différences, sont nulles, excepté pour les besoins rigoureusement théoriques. Méchain lui-même a reconnu, depuis, ce qu'il cacha à la commission, savoir, que la latitude qu'il avait trouvée pour Barcelone, en 1806-7 ne fut pas très-*sûre*.

Selon Bessel, (*Astr. Nachr.* 1842) la distance comprise entre l'équateur et le pôle contiendrait 10,000,855 mètres (621[illegible] *miles* + [illegible] *yards*) Selon Puissant, cette distance serait de 10,001,290 mètres ; et selon Chazallon de 10,001,790 mètres (621[illegible] *miles* + [illegible] *yards*, mesures américaines et anglaises). Ainsi, la distance de 10,000,000 mètres, établie en 1806-7, comme celle de l'équateur au pôle serait trop faible de 935 *yards*, selon Bessel ; de 1410 *yards*, selon Puissant, et de 195[illegible] *yards*, selon Chazallon. Les grandes triangulations faites dans les Indes (1832-42) donnent des résultats peu différents de ceux-ci : je le répète, pour tous les besoins du commerce, et de la vie ordinaire, ces différences sont absolument nulles, dans leur application au *mètre*.

Nous avons ainsi obtenu le *mètre*, unité de la longueur ou des mesures linéaires, base sur laquelle est appuyé tout le système.

Passons maintenant à ses multiples et sous-multiples. La nomenclature que l'on a imaginée pour le nouveau système est ingénieuse, commode et savante. C'est cette dernière qualité peut-être, qui, en donnant lieu à des idées bien fausses des difficultés du système, est cause que beaucoup de personnes lui refusent le peu de temps qui est réellement nécessaire pour le comprendre. Le fait est que cette nomenclature est simple, facile à comprendre, et facile à retenir. Pour ceux qui connaissent tant soit peu le latin et le grec, la nomenclature du système est comprise du premier abord, sans les moindres efforts. De plus, les dénominations possèdent le mérite précieux de suggérer à l'instant, *la nature et les quantités des mesures*. Il ne s'agit que d'apprendre *douze mots*, et de se familiariser avec les idées qu'ils représentent, et toute difficulté est vaincue. C'est dans la combinaison simple, naturelle et systématique de ces douze mots, que consiste toute la nomenclature du système. Ces mots ne sont pas plus français qu'anglais. Ils ne sont ni plus ni moins difficiles à apprendre pour un français que pour tout autre étranger. Ils pourraient donc être universellement adoptés.

Ces douze mots, sont : d'abord *quatre* de la série ascendante, pour exprimer les *multiples* ou les augmentations du mètre et des autres unités. Ils dérivent tous du *grec*, ce sont :

Déca,	qui veut dire	dix.
Hecto,	—	cent.
Kilo,	—	mille.
Myria,	—	dix mille.

Next, we have *three* words of the descending series, expressing the *divisions*, or diminutions of the metre, and other units. These are all derived from the *Latin*. They are :

Deci	signifying	tenth.
Centi	—	hundredth.
Milli	—	thousandth.

Now, prefix these seven words to the word *metre*, which we already know the meaning of, and we have the complete nomenclature of *long measure* under the french metrical system. Thus :

The myriametre	is	10,000 metres.
The kilometre	is	1,000 —
The hectometre	is	100 —
The decametre	is	10 —
The *metre*	is	1 metre.
The decimetre	is	1/10 of a metre.
The centimetre	is	1/100 —
The millimetre	is	1/1000 —

The *instruments* of long measure, established by law, and used, under the metrical system, are as follows : a double decametre, a decametre, a demi-decametre, a double metre, a *metre* (used in commerce as our yard-stick), a demi-metre, a double decimetre, and a decimetre.

The kilometre is generally used as the itinerary measure under this system, as we use the mile.

A rail way is so many kilometres in length : Versailles is 20 kilometres south-west of Paris. The kilometre is equal to 1093 $^1/_2$ of our yards. Our mile is equal to 1609 metres ; or 1.609 kilometre.

Measures of surface, or land measures.

The unit is called *are*, from the latin *area*, an open space, superficial extent, area. The *are*, unit of land measures, signifies the superficial extent contained within a square of which each side is 10 *metres* in length. It is therefore 10 metres square, and contains 100 square metres. We have then, by the combination of words above described :

The hectare	=	10,000 square metres.
The are	=	100 —
The centiare	=	1 square metre.

Under the metrical system, the *hectare* is used to express quantities of land, as the *acre* with us. The hectare is equivalent to not quite 2 $^1/_2$ acres, our measure, or to 2.471143 acres exactly. The land measurer's chain is a *decametre* (32 feet 9.700910 inches), of which each link is two decimetres in length.

Puis, *trois* mots de la série descendante, pour exprimer les sous-multiples ou divisions du mètre et des autres unités. Ils dérivent tous du *latin* : ce sont :

Déci,	qui veut dire	dixième.
Centi,	—	centième.
Milli,	—	millième.

Maintenant, en mettant ces sept mots devant le mot *mètre*, dont nous savons déjà la signification, nous aurons la nomenclature complète des mesures de longueur.

Le myriamètre	vaut	10,000	mètres.
Le kilomètre	—	1,000	mètres.
L'hectomètre	—	100	mètres.
Le décamètre	—	10	mètres.
Le mètre	—	1	mètre.
Le décimètre	—	1/10	d'un mètre.
Le centimètre	—	1/100	d'un mètre.
Le millimètre	—	1/1000	d'un mètre.

Les mesures de longueur établies par la loi, et en usage dans ce système, sont : le double-décamètre, décamètre, demi-décamètre, double-mètre, *mètre* (analogue au *yard* américain), demi-mètre, double-décimètre et décimètre.

Le *kilomètre* sert de mesure itinéraire, et correspond au *mile* américain. Un chemin de fer a tant de kilomètres. Versailles est à 20 kilomètres S. O. de Paris. Le kilomètre vaut 1093 1/2 des *yards* américains. Le *mile* vaut 1609 mètres ou 1.609 kilomètre.

Mesures de superficie, ou mesures agraires.

L'unité se nomme *are*, de latin, *area*, superficie. L'*are*, l'unité des mesures agraires, veut dire une portion de surface comprise dans un carré dont chaque côté a 10 mètres de longueur.

C'est donc un décamètre carré, et il contient 100 mètres carrés. La combinaison des mots, dont nous avons parlé plus haut, donne pour dénomination des mesures agraires.

Hectare	qui vaut	10,000	mètres carrés.
Are	—	100	mètres carrés.
Centiare	—	1	mètre carré.

L'hectare, qui sert dans ce système comme l'*acre* chez nous pour mesurer des quantités de terre, n'équivaut pas tout à fait à 2 1/2 *acres*. Il vaut exactement. 2.471143 *acres*. La chaîne d'arpenteur est un décamètre (32 *feet* + 9.700910 *inches*) dont chaque anneau a 2 décimètres de long.

Measures of volume, or solid measures.

The unit is called *stere*, from the *greek* στερεος, *solid.*

The *stere*, unit of solid measure, is *the cube of a metre*, and signifies the amount of matter contained in a mass one metre long, one metre broad, and one metre high; or in a solid body of six equal sides, like a die, of which each side is one metre square. We have then, by the combination of words above described, the following denominations indicative of solid measure, viz. :

The Decastere	which is	10 cubic metres.
Stere	—	1 cubic metre.
Decistere	—	$^1/_{10}$ of a cubic metre.

The *stere* of the metrical system is equal to 35.31658 english cubic feet. The instruments in common use, established by law, for measures of volume, or solid measure are, the *demi-decastere*, the *double stere* and the *stere*. These instruments are used chiefly for measuring firewood. The demi-decastere is not quite equivalent to $1\,^2/_5$ of our cord.

Measures of capacity.

LIQUID, AND DRY MEASURE.

The unit is called *litre*, from λιτρα (greek) a measure of liquids. The *litre*, unit of measures of capacity, is a vessel containing the *cube of the tenth part of the metre;* or the cube of a decimetre. It is a square vessel, which is, by interiour measurement, 1 decimetre in depth, and of which each side measures 1 decimetre ; or, in other words, a square vessel of which, by interiour measurement, each side, and the bottom, are square decimetres. Its multiples and divisions, are formed and named in the manner above described, viz :

The kilolitre	is	1,000 litres.
hectolitre	is	100 —
decalitre	is	10 —
litre	is	1 litre.
decilitre	is	$^1/_{10}$ of a litre.
centilitre	is	$^1/_{100}$ of a litre.

The *litre*, which is used, under this system, as the *quart* with us, is rather less than the quart, being 0.220097 parts of the British imperial gallon ; or, 1.760773 pint (a little more than $1\,^3/_4$ pints). The *hectolitre*, used in estimating large quantities of liquids, and grains, is equivalent to 22.009663 imperial gallons. The legal measures in use for liquid and dry measure are the *hectolitre*, *demi-hectolitre*, *double decalitre*, *decalitre*, *demi-decalitre*, *double litre*, *litre*, *demi-litre*, *double decilitre*, *decilitre*, *demi-decilitre*, *double centilitre* and *centilitre*. These measures have various forms, sug-

Mesures des solides, ou de volume.

L'unité se nomme *stère*, du *grec* στερεος (solide),

Le stère, unité des mesures solides, est 1 *mètre cube*, et exprime la quantité de matière qui se trouve dans une masse qui est de 1 mètre en longueur, de 1 mètre en hauteur et de 1 mètre en largeur; ou dans un corps solide, à six faces égales, comme un dé à jouer, dont chaque face est un mètre carré. Nous avons donc, en combinant, comme ci-dessus, le nom de l'unité avec les mots exprimant les multiples et sous-multiples, pour dénominations des mesures de solidité, les suivantes:

Décastère	qui vaut	10 mètres cubes.
Stère	—	1 mètre cube.
Décistère	—	1/10 d'un mètre cube.

Le *stère* du système métrique équivaut à 35.31658 *feet* cubiques anglais. Les mesures usitées dans le commerce, sont: le *demi-décastère*, le *double-stère* et le *stère*. Elles servent presqu'exclusivement pour la vente des bois de chauffage. Le demi-décastère ne vaut pas tout à fait 1 2/5 *cord* américain.

Mesures de capacité

pour les liquides et les matières sèches.

L'unité se nomme *litre*, du grec λιτρα, une mesure pour les liquides. Le *litre*, unité de mesures de capacité, est un vase dont la contenance égale *le cube de la dixième partie du mètre:* c'est le cube d'un décimètre; ou, en d'autres termes, le litre est un vase carré, dont, le fonds et les parois intérieures sont des décimètres carrés. Ses multiples et sous-multiples sont formés et nommés de la manière décrite ci-dessus pour les autres unités.

Ce sont :

Le kilolitre,	qui vaut.....	1,000	litres.
L'hectolitre,	—	100	—
Le décalitre,	—	10	—
Le litre,	—	1	—
Le décilitre,	—	1/10	d'un litre.
Le centilitre,	—	1/000	d'un litre.

Le *litre*, usité dans ce système comme le *quart* chez nous, contient un peu moins que le *quart*. Sa contenance est de 0.220097, *gallon* impérial de la Grande-Bretagne, ou 1.760773 du *pint* (un peu plus de 1 3/4 *pints*). L'hectolitre employé pour exprimer de grandes quantités de liquides et de grains, équivaut à 22.009663 *gallons impériaux*. Les mesures légales en usage sont l'hectolitre, le demi-hectolitre, double décalitre, décalitre, demi-décalitre, double litre, litre, demi-litre, double décilitre, décilitre, demi-décilitre, double centilitre et un centilitre. Ces mesures ont des formes diverses,

gested by experience, as best adapted to the purpose for which they are intended ; but their capacity is certain and graduated upon that of the square litre, constructed as above described. Specimens of all the forms used both in measures of capacity, and weights, are included in the donation of France to the United States, alluded to above.

Weights.

The unit is called *gramme*, from the greek γραμμα a small weight.

The gramme, unit of weights, is as intimately connected, by certain rule, with the base-metre, as any other unit of the system. The *gramme* is the weight of the 1000*dth* part of a cubic decimetre of distilled water, taken at its greatest density, which occurs at the temperature of 4 degrees above *zero* of the centigrade thermometer (39° 2 *Fahrenheit*) and weighed in a vacuum. Take an accurately constructed *litre* (which contains, as we have seen, 1 *decimetre cube*) ; fill the litre with distilled water, reduced to the temperature above mentioned (+ 4° centigrade), and weigh it in a vacuum. *The weight of that water is* 1 *kilogramme : or* 1000 *grammes.* Of course the 1000*dth* part of that weight, that is to say, *the weight of* 1 *centimetre cube* of the distilled water, is the *gramme*, unit of weights in the metrical decimal system. But, as the metal of which the vessel containing the water is made, is subject to dilatation, it is necessary, in order to give scientific exactness to the operation, to reduce the temperature of the vessel itself, by calculation, to the temperature of melting ice, or *zero* of the centigrade thermometer (32° Fahrenheit). According to the rule of nomenclature above described, we ave, as the denominations of the *weights* of the system, the following :

Myriagramme	=	10,000 grammes.
Kilogramme	=	1,000 —
Hectogramme	=	100 —
Decagramme	=	10 —
Gramme	=	1 gramme.
Decigramme	=	$^1/_{10}$ of a gramme.
Centigramme	=	$^1/_{100}$ ——
Milligramme	=	$^1/_{1000}$ ——

1,000 kilogrammes (1,000,000 grammes), which is the weight of 1 cubic metre of distilled water, represent the french *tun* (*tonneau*), used in estimating the burden of ships. This tun is equivalent to 19.70 cwt. avoirdupois. 100 kilogrammes represent the *metrical quintal*, used to express large quantities. The metrical quintal is equivalent to 1.97 cwt., or 220.5500 lbs. avoirdupois, or 268.0300 lbs. troy.

The weights used in commerce are as follows : weights of 50, of 20, of 10, of 5 kilogrammes, the double kilogramme, of 1 kilogramme, the demi-kilogramme, the double hectogramme, the hectogramme, the demi-hectogramme, the double decagramme, the decagramme, the demi-decagramme, the double gramme, the *gramme*, of 5 and 2 decigrammes, the decigramme, of 5 and 2 centigrammes, the centigramme, of 5 milligrammes, of 2 milligrammes and of 1 milligramme.

The *kilogramm* is used in commerce as our pound weight avoirdupois.

déterminées par l'usage, comme le mieux appropriées à leurs diverses destinations : mais leur contenance est fixe et suit toujours celle du litre carré, exécuté de la manière décrite ci-dessus. Des échantillons des poids et mesures, de toutes les formes usitées, se trouvent dans la collection dont nous avons parlé plus haut, offerte par la France aux Etats-Unis.

Poids.

L'unité se nomme *gramme*, du *grec* γραμμα,—un petit poids. Les rapports du gramme, l'unité des poids, avec le mètre-base, sont aussi intimes et aussi certains que ceux des autres unités du système métrique décimal.

Le gramme est le poids de la 1000e partie d'un décimètre cube d'eau distillée, prise à sa plus grande densité, qui arrive à la température de 4 degrés au-dessus de zéro du thermomètre *centigrade* (39°2 Fahrenheit), et pesée dans le vide. Prenez un litre, exécuté avec une scrupuleuse exactitude (dont la contenance est, comme nous l'avons vu, de 1 décimètre cube), remplissez ce litre d'eau distillée, ramenée à la température susdite (+ 4° centigrade), et pesez-la dans le vide. ***Le poids de cette eau sera de 1 kilogramme, ou 1000 grammes.***

Par conséquent, la 1000 partie de ce poids, c'est-à-dire ***le poids de 1 centimètre cube de l'eau distillée***, c'est le ***gramme***, l'unité des poids, dans le système métrique décimal. Mais, comme le métal dont est formé le vase qui contient l'eau, est sujet à la dilatation, on est forcé, pour donner à l'opération une exactitude scientifique, de ramener, par le calcul, la température de ce vase à celle de la glace fondante, ou au *zéro* centigrade (32° Fahrenheit). Selon la règle de nomenclature décrite ci-dessus, nous avons comme dénominations des poids du système — les suivantes :

Myriagramme,	qui vaut	10,000 grammes.
Kilogramme,	—	1,000 —
Hectogramme,	—	100 —
Décagramme,	—	10 —
Gramme	—	1 gramme
Décigramme,	—	1/10 d'un gramme.
Centigramme,	—	1/100 d'un gramme.
Milligramme.	—	1/1000 d'un gramme.

1,000 kilogrammes (1,000,000 grammes), poids de 1 mètre cube d'eau distillée, représentent le tonneau français, employé pour estimer le port des bâtiments. Ce tonneau équivaut à 19.70 *cwt.*, *avoirdupois*. 100 kilogrammes font le quintal métrique, usité pour exprimer de grandes quantités. Le quintal métrique équivaut à 1.97 *cwt*, ou 220.5500 *lbs.*, *avoirdupois*, ou 268.0300 *lbs. troy*. Les poids dont on se sert dans le commerce sont comme suit : poids de 50, 20, 10, 5, kilogrammes, le double kilogramme, 1 kilogramme, demi-kilogramme, double hectogramme, hectogramme, demi-hectogramme, double décagramme, décagramme, demi-décagramme, double gramme, gramme, de 5 et 2 décigrammes, décigramme, de 5 et 2 centigrammes, centigramme, de 5 et 2 milligrammes et de 1 milligramme.

Le *kilogramme*, dans le commerce, est analogue à notre *pound, avoirdu*

It is equivalent to 2.2055 lbs. of that weight. The gramm and its divisions are used by apothecaries, and to weigh gold and jewels, and in philosophical experiments. The *gramm* is equivalent to 15.434 troy grains; and the milligramm 0 01543 grains.

I have said that the whole nomenclature of the system was composed of *twelve* words. Seven of these, the numerals of multiplication and division, have been explained in their place. The other five have just been made the subject of explanation. They are the *five units*, viz :

Metre	the unit of	length.
Are	——	surface.
Stere	——	solidity
Litre	——	capacity.
Gramm	——	weight.

The combination of these five, with those seven, makes up, as must have been observed, all the names of the system. The ***termination*** of the denomination always expresses the ***kind***, and the ***numerals*** prefixed, the ***amount*** of the measure.

Standards or prototypes of the ***metre*** and the ***kilogramm***, in platinum, as the metal least subject to alteration, have been most carefully constructed, after the above rules, and are deposited among the Archives of the State. The standard metre, at the temperature of *zero* (the freezing point of water), indicates the true length of the metre. The standard kilogramm, weighed in a vacuum, gives the true weight of the kilogramm.

Money.

It now only remains to explain the currency of France, and show the manner in which it is connected with the metrical decimal system of weights and measures. The ***franc*** is the monetary unit. Its value is 18 cents 7 mills of our money. It is, by the rule of ***decimals***, divided into ***decimes*** (dimes or tenth parts) and ***centimes*** (cents or hundredth parts.) Accounts are kept in francs and centimes, as with us in dollars and cents. The franc is a silver coin, made of an alloy of which 9 parts in 10 are pure silver, and 1 copper. ***The franc piece weighs 5 gramms of this alloy.*** All silver coins, multiples, and divisions of the franc, weigh in proportion. Gold coins are made of an alloy, of which the proportions are the same as that of silver, viz : 9 parts pure gold, and 1 part copper. The alloy of copper coins is thus formed :

95	parts	copper.
4	—	tin.
1	—	zinc.
100		

pois; il équivaut à 2.2055 *lbs.* de ce dernier poids. Le gramme et ses sous-multiples sont employés par les pharmaciens, et pour peser l'or et les pierres précieuses, et dans les expériences scientifiques. Le gramme vaut 15.434 *troy grains*, et le milligramme vaut 0.01543 *troy grains*.

J'ai dit que toute la nomenclature du système se composait de douze mots. Sept de ces mots, les expressions numérales des multiples et des sous-multiples, ont été expliqués à leur place. Des cinq autres, nous venons d'en faire l'explication, ce sont les cinq *unités*.

Savoir :

Mètre, l'unité de longueur.
Are, — de superficie.
Stère, — de solidité.
Litre, — de capacité.
Gramme, — de poids.

L'on voit que tous les noms des mesures du système ne se font que par des combinaisons de ces cinq mots avec les sept autres. Le *genre* auquel la mesure appartient se trouve toujours indiqué par la *terminaison du nom*, et la *quantité* de la mesure par *les expressions numériques* ajoutées pour compléter les dénominations.

Deux étalons officiels, d'une parfaite exactitude, le *mètre* et le *kilogramme*, en platine, le métal le moins sujet à s'altérer, ont été exécutés avec le plus grand soin, et restent déposés aux Archives de l'Etat. Ce mètre prototype, ramené à la température de la glace fondante (*zéro*), donne la longueur exacte du *mètre*. Ce kilogramme prototype, pesé dans le vide, donne le poids exact du *kilogramme*.

Les Monnaies.

Il ne nous reste, maintenant, qu'à expliquer les monnaies françaises et à montrer les rapports qui existent entre elles, et le système métrique décimal des poids et mesures. Le *franc* est l'unité monétaire. Il vaut 18 *cents* 7 *mills* en monnaies américaines. D'après la règle de la division décimale, il est divisé en décimes (*dimes*, ou dixièmes parties), et en centimes (*cents*, ou centièmes parties). Dans la comptabilité, on se sert de francs et centimes, comme chez nous, de *dollars* et *cents*. *Le franc* est une pièce en argent, fabriquée d'un alliage dont 9 parties sur 10 sont d'argent pur, et 1 partie, de cuivre. *La pièce d'un franc pèse 5 grammes de cet alliage.* Toutes les monnaies d'argent, multiples et divisions du franc, pèsent proportionnellement. Les monnaies d'or se fabriquent avec un alliage dont les proportions sont les mêmes que celles des monnaies d'argent, — savoir : 9 parties d'or pur et 1 partie de cuivre. La composition de l'alliage dont se fabriquent les monnaies de bronze est comme ci-dessous.

95 parties de cuivre.
4 parties d'étain.
1 partie de zinc.

100

Of this alloy, the 1 centime-piece weighs 1 gramme, and all the copper coins, multiples of the centime, weigh in proportion. The coins of France, as established by law, are as follows:

GOLD.

Denomination.	*Weight.*	*Diameter.*
20 francs.	6.45161 gramms.	21 millimetres.
10 —	3.22580 —	17 —
5 — (1).	1.61290 —	14 —

SILVER.

5 francs.	25 gramms.	37 millimetres.
2 —	10 —	27 —
1 —	5 —	23 —
50 centimes.	2 1/2 —	18 —
20 —	1 —	15 —

COPPER.

10 centimes.	10 gramms.	30 millimetres.
5 —	5 —	25 —
2 —	2 —	20 —
1 —	1 —	15 —

We meet occasionally with gold, silver, and copper coins of other than the above denominations. But none such are now struck. They belong to old coinages, and are being gradually withdrawn from circulation. The copper currency, as above described, is regulated by recent statute (6 may 1852), and the new coins which the statute prescribes are just entering into circulation. The plate annexed presents fac-similes of one face of all the legal french coins, now in circulation.

Of the three species of standard coins:

3,100 francs in gold
200 — in silver } weigh 1 kilogramm.
10 — in copper

They may, thus, be employed with facility and confidence, in domestic and private affairs, from $^1/_2$ a gramm up to any desirable amount, in lieu of the regular brass and iron weights. It is by decimal division and by the weight, and diameter of the coins, that the connection is established between the currency of France and the metrical system of weights and measures. It was intended to make this connection more intimate and complete,

(1) The above table is corrected according to the imperial decree of January, 12, 1854, regulating the gold coinage. The gold 5 franc-piece will be soon issued.

De cet alliage, la pièce de 1 centime pèse 1 gramme ; et toutes les pièces de bronze, multiples du centime, pèsent proportionnellement. Les monnaies légales françaises sont les suivantes :

OR.

Noms et Valeurs.	*Poids.*	*Diamètre.*
20 francs.	6.45161 grammes.	21 millimètres.
10 —	3.22580 —	17 —
5 —	1.61290 —	14 —

ARGENT.

5 francs.	25 grammes.	37 millimètres.
2 —	10 —	27 —
1 —	5 —	23 —
50 centimes.	2 1/2 —	18 —
20 —	1 —	15 —

BRONZE.

10 centimes.	10 grammes.	30 millimètres.
5 —	5 —	25 —
2 —	2 —	20 —
1 —	1 —	15 —

Quelques pièces en or, en argent et en cuivre, autres que celles comprises dans les séries ci-dessus, se rencontrent encore dans la circulation, mais rarement. Depuis longtemps, la fabrication en a cessé. Ces pièces, d'ancienne fabrication, disparaissent de la circulation. Les monnaies de bronze, décrites ci-dessus, sont établies par une récente loi (6 mai 1852), et les nouvelles pièces, autorisées par cette loi, commencent à circuler. L'atlas annexé à cette lettre présente des *fac-simile* d'une face de toutes les monnaies légales actuelles de la France, qui ont été fabriquées jusqu'ici.

Des trois espèces de monnaies légales françaises,

3,100 francs en or
200 francs en argent } pèsent 1 kilogramme.
10 francs en bronze

L'on peut s'en servir avec confiance, en cas de besoin, au lieu des poids légaux en laiton, depuis un demi-gramme jusqu'au chiffre voulu. C'est par la division décimale et par le poids et le diamètre des pièces que s'établissent les rapports qui existent entre les monnaies françaises et le système métrique des poids et mesures. Pour reserrer cette union, le vœu de la loi était que, selon le diamètre des pièces, on pût, en les mettant bout à bout, en ligne

(1) La table ci-dessus est corrigée d'après le décret impérial du 12 janvier 1854 concernant les pièces de monnaie fabriquées en or. Les pièces de 5 francs en or doivent être prochainement fabriquées.

by so regulating the *diameter of the coins*, that by placing a certain number of them, in juxtaposition, touching each other, in a straight line, the *metre*, and its various divisions might be reproduced : thus affording a convenient mode of establishing, in case of need, the various divisions of lineal measure. Though this may be actually done, by combination of the figures of the above table, with sufficient exactitude for ordinary purposes, the rigorous and theoretic exactitude of the operation has been destroyed, by the practice adopted of placing letters in relief upon the edge of many of the coins. This practice is perhaps regrettable, and should be promptly abandoned, as impairing the beautiful harmony, and close connection of its parts with one another, that is so remarkable in the system. It would even be well, for the purpose of popularising the knowledge of this connection of the coins with the metrical system, and of making them convenient and useful as weights and measures, to stamp, upon the silver and copper coins, the weight and diameter of the pieces.

I have now given, my dear Sir, what seems to me a lucid description of the metrical decimal system of France. The most ordinary man cannot fail to understand it, in its minutest details, if he will bestow upon it even a small degree of attention. He can hardly fail to perceive how vastly superior it is over all others that have been invented, in its simplicity, its certainty, its convenience, and in that admirable cosmopolitan character recommending it to universal adoption. ***Metrical***, it is an homogeneous whole, connected throughout all its parts, with a certain scientific base, the metre. ***Decimal***, it introduces practically into all calculations of weights, measures, and money, the facility, certainty and convenience, which already characterize our calculations of dollars and cents. Let me again express the hope that the beautiful collection of its models, now in the Patent Office at Washington, will attract the attention of the intelligent merchants and legislators of my country ; and that steps will soon be taken to incorporate into our legislation, this system of weights, measures and coins. I know that this would be a work of labour, and difficulty, and temporary annoyance. I know, as was remarked by President Fillmore in a letter addressed to yourself about a year since, that « nations change their customs and habits with difficulty. » I'll grant, if you choose, that the whole present generation will live, and pass away, annoyed, and perplexed by the daily comparisons, and constant collisions of the new system with the old. But the evil will, in a few years, pass away with the generation itself : and the good will remain, a perpetual blessing to posterity. Our children, the rising generation, will be taught the new system in our schools ; they will become gradually accustomed to it, in daily domestic practice ; and when, in a few years, they shall be ready to enter upon the active duties of life, they will find themselves familiar with the system, in its minutest details : and, then, the work is done ; the transformation complete ; the metrical decimal system will have entered completely into the habits of the country. Sir, the prevailing systems of the United States have had their day : and they were useful in their day. But they are now antiquated. and they should be laid by, with antiquated things. We should put them where we have put our great grandmothers' hoops, and our grandfathers' knee-breeches ; we should put them where we have put pole-boats, corduroy roads, and rumbling stage-coaches ; where we have put aerial telegraphs, and flint fire-locks. And we should make haste to put them away. The difficulties of the work of reformation are every year increasing in a frightful progression. Think of the

droite, trouver la longueur du mètre et de ses parties. Si un pareil rapprochement a pu avoir lieu autrefois, il serait détruit aujourd'hui par la différence qui doit résulter des lettres de la tranche, qui sont en relief sur beaucoup des monnaies actuelles. Cet usage est, peut-être, regrettable et devrait être promptement abandonné, comme attaquant l'harmonie et l'unité qui distinguent si remarquablement le système. Il serait même à désirer, afin de rendre familiers aux populations les rapports qui existent entre les monnaies et les poids et mesures, et de mettre à la portée de tout le monde un moyen facile et commode de rétablir, au besoin, les unités métriques, que le poids et le diamètre des diverses pièces fussent estampés sur une de leurs faces, au moins en ce qui concerne les monnaies d'argent et de bronze.

Ici, mon cher Monsieur Vattemare, se termine la description que je m'étais proposé de faire du système métrique décimal de la France. Elle me semble ne pas manquer de clarté. En la lisant avec un peu d'attention, l'homme le plus ordinaire pourra comprendre ce système, dans tous ses détails. Il s'apercevera, bien certainement, combien ce système est supérieur à tout ce qui a été inventé jusqu'ici, par sa simplicité, par sa certitude, par la facilité d'usage qui le distingue, et par cet admirable caractère cosmopolite qui le rend propre à l'adoption universelle. ***Métrique.*** — C'est un tout homogène, se rapportant, dans toutes ses parties, à une base certaine et scientifique. ***Décimal.*** — Il introduit dans tous les calculs des poids, mesures et monnaies, la même facilité et la même sûreté qui nous sont déjà si utiles dans nos calculs de *dollars* et *cents*. Permettez-moi d'émettre encore le vœu que la belle collection de ses modèles, déposée au *Patent office* à Washington, puisse attirer l'attention des négociants intelligents et des législateurs de mon pays, et que des mesures soient bientôt prises pour incorporer dans notre législation, ce système de poids, mesures et monnaies. Je sais bien qu'il y aura de la difficulté et un embarras momentané. Je sais, comme l'a remarqué M. le président Fillmore dans une lettre qu'il vous a adressée, il y a environ un an, que « les peuples changent difficilement leurs coutumes et leurs habitudes. » Je conviendrai, si vous voulez, que toute la génération présente vivra, et passera, gênée et embarrassée par les comparaisons journalières et les collisions perpétuelles du nouveau système avec le vieux. Mais le mal disparaîtra dans quelques années, avec la génération elle-même : il n'y aura de permanent que le bien. Nos enfants apprendront le nouveau système dans les écoles. Il leur deviendra familier, peu à peu, dans l'usage journalier, domestique, qui se pratiquera devant leurs yeux ; et quand, dans quelques années, ils seront prêts à entrer sur la scène du monde, ils se trouveront au fait de tous les détails du système. Alors la transformation sera accomplie : le système métrique décimal sera complétement entré dans les habitudes du pays. Les systèmes actuels des poids et mesures aux Etats-Unis ont fait leur temps, et ils ont été utiles dans leur temps. Mais, aujourd'hui, ils ont vieilli, et ils devraient être mis de côté, avec les meubles d'autrefois dont on ne se sert plus. Nous devrions les mettre où nous avons mis les paniers (*the hoops*) de nos aïeules, et les culottes courtes de nos grands-pères ; nous devrions les mettre où nous avons mis les bateaux à crocs, les routes-*corduroy*, et les lourdes diligences de l'ancien temps ; où nous avons

enormous rate of our national progress — of the march of our population — of the annual growth and enlargement of our commercial relations, interiour, and exteriour! Indeed, when these things are considered, it seems that the legislators of to-day, who devolve upon those of to-morrow, the consummation of this great reform are incurring, before posterity, a fearful responsability. And are we not in the habit of exaggerating the difficulties of this transformation? It is being effected in France easily, steadily, and without any of those hiccups, coughs, colics, and broken bones, of which timid politico-economical doctors are so apprehensive. I say it is being effected in France ; for it is only since January 1840, that the exclusive use of the weights and measures of the metrical decimal system has been obligatory throughout France. Prior to that date, the use of old weights and measures was permitted, for certain purposes, concurrently with those of the new system.

By way of avoiding too abrupt changes, in so important matters as the weights, measures, and currency of nations, many progressive political economists ask, if it would not be well to commence by agreeing upon, and adopting some common system — not necessarily the new system of France — but some other, a better, if a better can be found or invented — *for use at all custom-houses?* The *Zollverein*, it is alledged, is trying this among the various german states composing that Association, and with highly satisfactory results. It is true, the Zollverein has established its *pound* as equivalent to $^1/_2$ a kilogramm (500 gramms) ; its *foot* to 30 centimetres : and its *pot* to 1 $^1/_2$ litres. And it is said with the vulgar adage « Half a loaf is better than none. » But so necessary, so urgent, so inevitable, sooner or later, do I consider the total and universal substitution of some one, the best, system, in place of the multifarious systems now prevailing throughout the world, that I should fear to be retarding the final desirable consummation, by the adoption of half-way measures ; which, operating partial improvement, and making our situation a little easier, would weaken the inducement to radical, and thorough change. If a capital operation is momently becoming more necessary, and more difficult, it is the dictate of prudence and good sense to perform it at once. Off, with the leg!

Permit me now, before closing this letter, to expose a few objections to the metrical decimal system as it is : and suggest two or three amendments, worthy of consideration, when the question of general adoption shall be seriously taken up by the United States and England.

Intended for France, and perfectly fitted, perhaps, without change, for exclusive french use, the illustrious authors of the system, did not sufficiently remember in the arrangement of its details, that the day might come when all other nations would desire to share in its advantages. They made it in some of its details, too strictly french, when they might, without lessening its value for France particularly, have given it an attractive cosmopo-

mis les télégraphes aériens et les fusils à pierre ; et nous devrions avoir hâte de les mettre de côté. Les difficultés s'accumulent devant cette œuvre de réforme, tous les ans, d'une manière effrayante, avec une progression toujours croissante.

Considérez la rapidité phénoménale de notre progrès comme nation, la marche rapide et constante de notre population, et l'extension énorme que prennent tous les ans nos rapports commerciaux, à l'intérieur et à l'extérieur ! Vraiment, en songeant à tout cela, on ne peut s'empêcher de dire que les législateurs d'aujourd'hui, qui transmettent à ceux de demain, l'accomplissement de cette grande réforme, se chargent d'une effrayante responsabilité envers la postérité.

Et ne sommes-nous pas dans l'habitude d'exagérer les difficultés qui s'opposent à l'accomplissement de cette réforme? Elle s'effectue en France, aisément, avec régularité, et sans secousses. On n'y voit rien de ces hoquets, de ces toux, de ces os rompus, dont des méticuleux docteurs politico-économistes ont si grand peur. Je dis qu'elle s'effectue actuellement en France, car il faut se rappeler que c'est seulement depuis le 1er janvier 1840 que l'emploi exclusif des poids et mesures du système métrique est devenu obligatoire dans ce pays. Jusqu'à cette dernière époque, l'usage des anciens poids et mesures était permis, concurremment avec ceux du nouveau système.

Pour éviter une transition trop brusque à l'égard des intérêts aussi graves que les poids, mesures et monnaies des nations, beaucoup d'économistes demandent si on ne ferait pas bien de commencer par s'entendre pour adopter un système commun — non nécessairement le système métrique de France—mais quelque autre—un meilleur, si on peut en trouver, ou inventer un meilleur—pour l'usage commun dans toutes les douanes ? Le Zollverein, dit-on, en fait l'essai, dans ce moment, pour les divers Etats d'Allemagne dont se compose cette association, et ce, avec un succès des plus satisfaisants. C'est vrai, le Zollverein a basé ses mesures communes sur le système métrique, en faisant sa *livre* de 500 grammes (un demi-kilogramme), son pied de 30 centimètres, et son *pot* de 1 litre et demi ; et l'on peut m'opposer encore le proverbe vulgaire: « ***Un demi-pain vaut mieux que rien.*** » Mais je considère comme si nécessaire, si urgente, et tôt ou tard si inévitable la substitution totale et universelle d'un système quelconque — le meilleur —aux systèmes multiformes qui existent de par le monde, que je craindrais de retarder cette désirable consommation définitive, par l'adoption de demi-réformes. Ces demi-réformes, en opérant des améliorations partielles, en rendant la situation un peu plus aisée, pourrait affaiblir les motifs qui doivent déterminer la réforme radicale et totale. Lorsqu'une opération capitale devient, de moment en moment, plus nécessaire et plus difficile, la prudence et le bon sens ordonnent de la faire promptement. — Enlevez la jambe!

Permettez-moi, ici, avant de terminer cette lettre, d'exposer quelques objections contre l'organisation actuelle du système métrique décimal, et de suggérer deux ou trois amendements dignes, peut-être, d'attention, quand la question de l'adoption générale sera sérieusement proposée à la considération des Etats-Unis et de l'Angleterre.

Le système était fait pour la France, et se trouve peut-être assez bien adapté, sans changement, à l'usage exclusif français. Mais, ses illustres auteurs, dans l'arrangement de ses détails, ne se sont pas toujours souvenus que le jour pourrait arriver où toutes les autres nations désireraient participer à ses bienfaits. Ils l'ont fait, dans quelques uns de ses détails, trop

litan air. But, fortunately as remarked above, its essential universality of character, was not impaired. *It may be readily adapted to fit the world.* I will now proceed with my objections and suggested amendments.

1st. With a view to render the nomenclature of the system more fit for adoption without change, by all nations, and into all languages, I would recommend a modification, not of the etymology, but of the orthography of the *names of the units.* The names of the units, as they now stand, are liable to be very differently pronounced even in the same country. In the United States, for instance, some persons would make the names of the units, monosyllables, others dissyllables: some would make the vowels long, others would make them short: some would say *liter*; others, *litter*; others, *leeter*; and others, again *leetre*, (one syllable) like the French. The difference of pronunciation of the same word in different countries, would be so great as to make it impossible for foreigners to recognize the names of the units, except by the eye, in writing. I propose therefore, to apply to all of them a rule of modification, which, not altering the etymology, will have the advantage of making unquestionable monosyllables of them all; and will establish the orthography in such a manner, that the words must produce almost identically the same sounds in all the languages of Europe; and variation of pronunciation in the same country will be unknown. Thus let

Metre	become	Mett.
Are	—	Arr.
Stere	—	Sterr.
Gramme	—	Gramm.
Litre	—	Litt.

Every Frenchman, at first sight, would pronounce these words almost exactly as we would in the United States. He cannot, by the rules of his language, do otherwise. In England and the United States the pronunciation would be absolutely uniform. In Germany and all over Europe, those letters would produce one and the same sound. But the final consonants must be preserved double: otherwise, grave changes of pronunciation will immediately follow in France, and perhaps elsewhere. The names of the units thus modified, should be *invariable*, having no plural termination. The figures prefixed to them would sufficiently indicate their number, whether singular or plural. This new orthography should be preserved, throughout all the combinations of the nomenclature of the system.

2nd. The denominations given to the multiples and divisions of the units, and to the weights and measures of the system, are unnecessarily and inconveniently various. Of what real use for instance is the denomination *kilolitre*? Why not say, when that quantity is to be expressed, 1000 *litres*, or 10 *hectolitres*? And why have measures that are legally named, and stamped — as we see they are in the enumeration, by Mr. Silbermann, of the sets forwar-

exclusivement français, pendant qu'ils auraient pu, sans le rendre moins propre à l'usage spécial de la France, lui imprimer un air cosmopolite prévenant. Mais heureusement, comme je l'ai dit plus haut, son essentielle universalité de caractère lui est restée intacte. Il pourrait facilement s'ajuster au monde entier.

Je passe maintenant à la considération des amendements dont le système me paraît susceptible.

1° Afin de rendre la nomenclature du système plus propre à être adoptée, sans changement, par toutes les nations et dans toutes les langues, je propose une modification, non pas de l'étymologie, mais bien de l'orthographe des *noms des unités*. Les noms des unités, comme ils sont actuellement écrits, sont sujets à être prononcés, même dans le même pays, de manières toutes diverses. Aux Etats-Unis, par exemple, quelques-uns en feraient des monosyllabes, d'autres des dissyllabes; quelques-uns en feraient les voyelles longues, d'autres les feraient brèves; quelques-uns diraient *liter*, d'autres *litter*, d'autres *leeter*, et d'autres encore *leetre* (une syllabe) comme en France. La différence de la prononciation du même mot, en divers pays, serait si grande qu'il deviendrait impossible pour les étrangers de reconnaître les noms des unités, excepté par l'œil lorsqu'ils seraient écrits. Je voudrais, alors, appliquer aux noms de toutes les unités, une règle de modification, qui, tout en laissant intacte l'étymologie des noms, auraient l'avantage d'en faire des monosyllabes incontestables; et, de plus, d'en établir l'orthographe de manière que les mots produisissent, presque identiquement, les mêmes sons dans toutes les langues d'Europe, et que la diversité de prononciation, dans le même pays, n'existât pas. Ainsi, que

Mètre	devienne	*Mett.*
Are	—	*Arr.*
Stère	—	*Sterr.*
Gramme	—	*Gramm.*
Litre	—	*Litt.*

Tout Français, au premier abord, prononcerait ces mots nouveaux presqu'exactement comme nous autres Américains. Les règles de la langue française ne lui permettent pas de faire autrement. En Angleterre et aux Etats-Unis, la prononciation en serait absolument uniforme. En Allemagne et dans toute l'Europe, ces lettres donneraient un et même son. Mais les consonnes finales doivent rester doubles, autrement de graves variations de la prononciation s'ensuivraient immédiatement en France et peut-être ailleurs. Les noms des unités, ainsi modifiés, devraient être *invariables*, sans terminaison plurielle. Les chiffres qui y seraient ajoutés indiqueraient suffisamment le nombre, soit singulier, soit pluriel. Cette orthographe nouvelle serait suivie dans toutes les combinaisons de la nomenclature du système.

2° Les noms donnés aux multiples et aux divisions des unités et aux poids et mesures du système sont plus variés, ce me semble, qu'il ne faut pour être utiles et commodes. A quoi sert, par exemple, la dénomination *kilolitre*? Pourquoi ne dirait-on pas, quand on voudrait exprimer cette quantité, 1,000 litres, ou 10 hectolitres? Pourquoi a-t-on des mesures, légalement nommées et estampillées, *double décalitre*, *décalitre*, *demi-décalitre*, *double*

ded to Washington — *double decalitre, decalitre, demi-decalitre, double decilitre, decilitre, demi decilitre*? Why not say instead **20 *litres*, 10 *litres*, 5 *litres*, 20 *centilitres*, 10 *centilitres*, 5 *centilitres*?** The ***franc*** is simply, conveniently, and quite as decimally, divided into ***centimes***, as we see above. The ***litre*** should be divided into ***centilitres***. We hear nothing in monetary divisions of ***decimes*** and ***demi-decimes***. We should hear no more, in measures of capacity, of ***decilitres***, and ***demi-decilitres*** This reform should be applied to the multiples and divisions of all the units throughout the series composing the system. The actuel denominations are scientific, and strictly systematic, it is true : but it is well not to incumber a system, intended for universal and popular use, with more technical terms than are strictly necessary, and convenient. To the masses, the terms objected to are not suggestive. They are inconvenient, and perplexing for they require complicated operations of the mind. Their incorporation practically into the system is doubtless one main reason why in certain localities of France it is found so difficult to substitute definitively the new system in place of the old. Reform would much facilitate business transactions, especially among the lower classes. **15 *litres*** is a quantity more promptly apprehended, and more easily expressed by an ignorant man, than **1 *decalitre and a half***. The first expression too would be understood ***in all languages***; the last, would not be. The subject matter of the present objection originated perhaps in a pardonable scientific pedantry. ***Savans*** are not usually the most practical of men. But the clinging to actual denominations, in spite of the exposed inconvenience of them, would be a deference to the illustrious authors of the system, unworthy of the practical utilitarian age in which we live. We are seeking a system for universal adoption, fitted for the convenient daily use of the masses in all countries, not for the exclusive use of the privileged and educated few. The modification leaves untouched the base of the system. The principle of construction and the mode of combination by which the actual denominations have been established. remain the same. I would therefore suggest that the United States and England, on adopting the metrical system, should fix the denominations of the multiples and divisions of the several units, and the names of the measures, as follows.

Long Measures

Myriametre.....	10,000 metres.
Kilometre.....	1,000 metres.
Metre.....	1 metre.
Centimetre.....	1/100 of a metre.
Millimetre.....	1/1000 of a metre.

The *myriametre* is retained for the expression of immense astronomical

décilitre, *décilitre*, *demi-décilitre*. Pourquoi ne pas dire tout simplement au lieu de ces noms, 20 *litres*, 10 *litres*, 5 *litres*, 20 *centilitres*, 10 *centilitres*, 5 *centilitres*? Le franc est divisé en centimes, comme on le voit dans la table ci-dessus. C'est simple, c'est commode, et, en même temps parfaitement conforme aux fractions décimales qui sont la règle du système. Eh bien ! le *litre* devrait, de même, se diviser en *centilitres*. Dans la comptabilité, on n'entend pas parler de *décimes* et de *demi-décimes*. Nous ne devrions pas, non plus entendre parler de *décilitres*, et de *demi-décilitres*, comme mesures de capacité. Cette réforme serait applicable à tous les multiples, et sous-multiples des unités, dans toutes les séries du système. Ainsi, le système deviendrait plus simple, plus facile à comprendre et à retenir, et, conséquemment plus acceptable pour les populations illettrées qui se sentent peut-être une prévention contre le système, à cause de sa nomenclature savante et trop complexe, qui les embarrasse. Les dénominations actuelles sont scientifiques et rigoureusement systématiques ; c'est vrai : mais en bonne règle, on ne doit pas surchager un système destiné à l'usage général et populaire, de plus de termes techniques qu'il n'en faut strictement pour être intelligible et commode. Pour les masses, les termes dont il est question ici, ne suggèrent absolument rien d'eux-mêmes. En pratique, ils sont incommodes et embarrassants, parce qu'ils exigent des opérations mentales compliquées. Ils sont sans doute, une des causes principales qui font que dans certaines localités de France, on trouve de la difficulté à substituer le nouveau système aux anciens. Cette réforme faciliterait beaucoup les transactions, surtout pour les classes inférieures. 15 *litres* est une quantité plus promptement saisie et plus facilement exprimée, par un homme sans instruction, que 1 *décalitre et demi*. L'origine de la présente objection se trouve peut-être dans un pédantisme scientifique bien pardonnable, du reste, de la part des savants qui ne sont pas, d'ordinaire, les plus pratiques des hommes. Mais, adhérer aux dénominations actuelles, malgré les inconvénients qu'on est en droit d'y attribuer, ce serait témoigner une déférence pour les illustres auteurs de ce système, indigne de ce siècle pratique et utilitairien, où nous vivons. Nous cherchons un système, non pour l'emploi exclusif des classes privilégiées et instruites, mais pour l'adoption universelle — un système propre à l'usage commode, journalier, des masses dans tous les pays, et qui répondra, en même temps, aux grands besoins communs internationaux du commerce. La modification proposée ne touche pas à la base du système. Son principe de construction et le mode de combinaison adopté pour former la nomenclature du système restent les mêmes. Je recommanderais alors, que les Etats-Unis et l'Angleterre, en adoptant le système métrique, apportassent à son organisation actuelle les modifications suivantes, en ce qui concerne les multiples et les sous-multiples des unités.

Mesures de longueur.

Myriamètre.....	10,000 mètres.
Kilomètre.....	1,000 mètres.
Mètre.....	1 mètre.
Centimètre.....	1/100 de 1 mètre
Millimètre.....	1/1000 de 1 mètre.

Le *Myriamètre* serait conservé pour exprimer d'immenses distances as-

distances ; the *kilometre*, for itinerary measure ; the *millimetre*, also, for scientific purposes.

The *usual measures* employed in commerce would be the same as at present ; only they would be called measures of 20, 10, 5, 2 metres ; of 1 metre ; of a demi-metre, or 50 centimetres ; of 20, and of 10 centimetres.

Measures of surface or Land Measures.

As for these, they are probably not susceptible of any advantageous modifications, by virtue of the amendment proposed. They would remain therefore

Hectare.....	10,000 square metres.
Are.....	100 square metres.
Centiare.....	1 square metre.

Measures of Volume, or solid Measures.

The following denominations would be found more convenient in practice than those actually used. They accord too better with the denominations of the other units.

Hectostere.....	100 cubic metres.
Stere.....	1 cubic metre.
Centistère.....	1/100 of a cubic metre.

The *usual measures* would remain as at present : only they would be called, measures of 5 and 2 steres, and of 1 stere.

Weights.

Kilogramme.....	1000 grammes.
Gramme.....	1 gramme.
Milligramme.....	1/1000 of a gramme.

The tun, *tonneau*, (1000 kilogrammes), for estimating the burden of ships, and the *metrical quintal* (100 kilogrammes) for expressing large quantities, would be retained.

The *weights*, usually employed in commerce would be the same as now, but called (rejecting the learned series of denominations given above by Mr. Silbermann,) as follows : weights of 50, 20, 10, 5, 2 kilogrammes ; of 1 kilogramme ; of a demi-kilogramme, or 500 grammes ; of 200, 100, 50, 20, 10, 5, 2 grammes ; of 1 gramme ; of a demi-gramme, or 500 milligrammes ; of 200, 100, 50, 20, 10, 5, 2 milligrammes, and of 1 milligramme.

tronomiques; le *kilomètre* pour la mesure itinéraire; et le *millimètre* pour les besoins scientifiques.

Les mesures usitées dans le commerce seraient les mêmes que celles d'aujourd'hui; seulement, elles se nommeraient mesures de 20, 10, 5 et 2 mètres; de 1 mètre, d'un demi-mètre ou de 50 centimètres; de 20 et 10 centimètres.

Mesures de superficie.

Quant à celles-ci, elles ne sont probablement pas susceptibles d'aucune amélioration, en vertu de l'amendement proposé du système. Elles resteraient donc :

Hectare	10,000	mètres carrés.
Are	100	
Centiare	1	mètre carré.

Mesures de volume, ou des solides.

L'on trouverait les divisions suivantes plus commodes dans l'usage que ne le sont celles actuellement usitées. Elles s'accordent mieux, aussi, avec les divisions choisies pour les autres unités.

Hectostère	100	mètres cubes.
Stère	1	mètre cube.
Centistère	1/100	de 1 mètre cube.

Les mesures usitées seraient les mêmes qu'à présent; seulement on les nommerait mesures de 5 et 2 stères, et de 1 stère.

Poids : Mesures de pesanteur.

Kilogramme	1,000	grammes
Gramme	1	gramme.
Milligramme	1/100	de 1 gramme.

Le *tonneau* (tun) de 1,000 kilogrammes, pour mesurer le port des bâtiments, et le *quintal métrique* pour exprimer de grandes quantités, seraient conservés.

Les mesures dont on se servirait dans le commerce seraient les mêmes qu'à présent; seulement, (mettant de côté la longue suite de dénominations diverses spécifiées dans l'extrait ci-dessus de la lettre de M. Silbermann), on les nommerait poids de 50, 20, 10, 5, 2 kilogrammes, de 1 kilogramme, demi-kilogramme ou 500 grammes : de 200, 100, 50, 20, 10, 5, 2 grammes, de 1 gramme, demi-gramme, ou 500 milligrammes : de 200, 100, 50, 20, 10, 5, 2 milligrammes et de 1 milligramme.

Liquid and dry measures.

Hectolitre.....	100 litres.
Litre.....	1 litre.
Centilitre.....	1/100 of a litre.

The *usual measures* would be the same as at present, but denominated, measures of 1 hectolitre; demi-hectolitre, or 50 litres; of 20, 10, 5, 2 litres; of 1 litre; the demi-litre, or 50 centilitres; of 20, 10, 5, 2 centilitres, and of 1 centilitre.

I hold it to be impossible for an intelligent man to run his eye over the above series of denominations and figures, and not admit, that while they belong as rigorously to the metrical system, as the denominations actually used, they are at the same time more simple, more convenient, more easily apprehended, and therefore better fitted for universal adoption.

3d. It seems to me that a rule may be found for the establishment of the *five units* of the system, that shall have at least the advantage over the mode actually pursued, in being more simple and more easily remembered, and perhaps more rigorously systematic. To explain my objection more fully, under the actual arrangement, the units are thus expressed.

Metre	a certain portion of the earth's meridian	1 metre.
Are	a surface of.....	100 square metres.
Stere	a mass of.....	1 cubic metre.
Gramme	a weight of distilled water.....	1 cubic centimetre.
Litre	a vessel containing.....	1 cubic decimetre.

Now would it not be better if we could say—The units are

Metre	a certain portion of the earth's meridian.	1 metre.
Are	a surface of.....	1 metre square.
Stere	a mass of.....	1 metre cube.
Gramme	a weight of distilled water.....	1 metre cube.
Litre	a vessel containing.....	1 metre cube.

But the length of the *metre*, as actually fixed, renders this simple and logical mode of determining the value of the other units, impossible in practice. Let us remove the difficulty by declaring the *metre* the base of the system, to be *one tenth part of the actual metre*; not, one ten millionth part, but *one hundred millionth part of the quadrant of the earth's meridian*: that is to say, 1 *decimetre* of the actual system.

This modification would not affect in the slightest degree the principle of construction, and nomenclature of the system. It would only involve a partial shifting of the names. Thus the metre, diminished in length as proposed, and the other units formed upon it as at present, the actual

Myriametre	would become	Deca-Myrimetre.

Mesures de capacité

POUR DES LIQUIDES ET MATIÈRES SÈCHES;

Hectolitre	100 litres
Litre	1 litre.
Centilitre	1/100 de 1 litre.

Les mesures usuelles ne seraient pas changées; mais on les nommerait 1 hectolitre, demi-hectolitre ou 50 litres; 20, 10, 5, 2 litres, 1 litre, demi-litre, ou 50 centilitres; 20, 10, 5, 2 centilitres, et 1 centilitre.

Un homme compétent et pratique ne pourrait pas, ce me semble, passer sous les yeux les dénominations et les chiffres établis dans les séries données ci-dessus, sans admettre que, tout en appartenant au système métrique aussi rigoureusement que les dénominations actuellement en usage, elles seraient, en même temps, plus simples, plus commodes, plus faciles à apprendre, et, conséquemment, plus propres à l'adoption universelle.

3° Je pense qu'une règle peut se trouver pour déterminer les cinq unités du système, qui aurait l'avantage sur celle que l'on a adoptée pour trouver les unités actuelles, d'être plus simple, plus facile à retenir, et peut-être plus rigoureusement systématique. Pour exposer l'objection plus clairement : — selon l'organisation actuelle, les unités s'expriment de cette manière : —

Mètre, un arc du méridien terrestre....	1 mètre.
Are, une surface de.....	100 mètres carrés.
Stère, un volume de.....	1 mètre cube.
Gramme, un poids d'eau distillée.....	1 centimètre cube.
Litre, un vase contenant.....	1 décimètre cube.

Je dis qu'il serait mieux, si nous pouvions dire : — Les unités sont

Mètre, un arc du méridien terrestre....	1 *mètre.*
Are, une surface de.....	1 *mètre carré.*
Stère, un volume de.....	1 *mètre cube.*
Gramme, un poids d'eau distillée.....	1 *mètre cube.*
Litre, un vase contenant.....	1 *mètre cube.*

Mais la longueur du mètre, comme il est fixé actuellement, rend impossible ce mode simple et logique de fixer la valeur des autres unités. Levons la difficulté en déclarant que le *mètre*, la base du système, sera *la dixième partie du mètre actuel*, non la dix millionième partie, mais *la cent millionième partie du quart du méridien terrestre*. C'est-à-dire 1 *décimètre* du système actuel.

Cette modification n'affecterait en rien les principes de la construction et de la nomenclature du système. Elle amènerait seulement un échange réciproque partiel des noms. Ainsi, le *mètre*, diminué en longueur de la manière indiquée, et les autres unités en dérivant comme à présent, les noms des divisions des unités se trouveraient modifiés comme suit :

Dans les mesures de longueur,

Myriamètre deviendrait..... Déca-myrimètre.

Kilometre	would become	Myrimetre.
Metre	—	Decametre.
Decimetre	—	***Metre.***
Centimetre	—	Decimetre.
Millimetre	—	Centimetre.

The same yard-stick would be used in stores, only it would be called ***decametre***, or familiarly ***deca*** (as ***kilo*** is used for ***kilogramme***) instead of ***metre***. Itinerary measure would remain exactly as it is, only the ***kilometre*** would be called ***myrimetre***. The land measurer's chain would be styled a ***hectometre*** instead of decametre. The actual

Hectare	would become	Hecto-Myriare.
Are	—	Myriare.
Centiare	—	Hectare.

The ***hecto-myriare*** (employed as our acre) would be familiarly called ***hectom***. In solid measure, the actual

Decastere	would become	Myristere.
Stere	—	Kilostere.
Decistere	—	Hectostere.

In weights, the actual

Kilogramme	would become	Gramme.
Gramme	—	Milligramme.
Milligramme	—	Milli-Milligramme.

The last named quantity would be commonly styled ***milli-mil.***

In liquid and dry measures, there would occur no change whatever — not even a shifting of names, only we would say : the litre is a vessel of which the capacity is ***one cubic metre***, instead, as now, of one cubic decimetre; for the decimetre would have become the metre, under the new arrangement.

4th. As for the ***money of France***, I should be sorry to see it adopted by us, with the metrical system of weights and measures, unless we introduced, at the same time, an important modification of the ***monetary unit.*** The connection with the metrical system, by weight, and diameter of the coins, and by decimal divisions, should remain unimpaired; but the actual unit of this country, the ***franc*** (equivalent to 18 cents 7 mills of our money) ***is too small.*** Fortunately, they have here a silver coin, the ***five franc-piece***, of nearly the same value with our dollar. Let us take the five franc-piece, of the actual weight and composition, change its name, divide it decimally into cents and mills, and, making it the ***unit of money,*** accept french moneys, with french weights and measures. The change of unit would in no way affect the relation of the currency with the system. What name shall be given to the unit? It should not be ***dollar;*** it should not be ***franc***. These being already well known units, in common use, and of different values

Kilomètre	deviendrait		Myrimètre.
Mètre	—		Décamètre.
Décimètre	—		*Mètre.*
Centimètre	—		Décimètre.
Millimètre	—		Centimètre.

Le même *yard-stick* serait usité dans les magasins, seulement on le nommerait *décamètre*, ou familièrement *déca* (comme l'on dit *kilo* pour *kilogramme*), au lieu de *mètre*. La mesure itinéraire resterait exactement comme elle est ; seulement, le *kilomètre* actuel serait nommé *myrimètre*. La chaîne d'arpenteur serait un *hectomètre*, au lieu d'être un *décamètre*.

Les changements suivants se feraient dans les mesures de *superficie*.

Hectare	deviendrait		Hecto-myriare.
Are	—		Myriare.
Centiare	—		Hectare.

L'*hecto-myriare* (employé comme notre *acre* aux Etats-Unis) serait familièrement nommé *hectom*.

Les changements suivants se feraient dans les mesures de *volume* :

Décastère	deviendrait		Myristère.
Stère	—		Kilostère.
Décistère	—		Hectostère.

Dans les poids, les changements suivants auraient lieu :

Kilogramme	deviendrait		Gramme.
Gramme	—		Milligramme.
Milligramme	—		Milli-milligramme.

La dernière quantité (milli-milligramme) serait ordinairement nommée *milli-mil*.

Dans les mesures de capacité pour liquides et matières sèches, il n'y aurait aucun changement. Les noms resteraient comme ils sont. Seulement on dirait le *litre* est un vase dont la capacité est de 1 *mètre cube*, au lieu de 1 décimètre cube comme à présent.

4° Quant aux *monnaies françaises*, je ne les verrais pas avec plaisir adoptées par nous, à moins qu'il n'y soit apporté, en même temps, une modification importante de l'unité monétaire. La connexion entre elles et le système métrique, par le poids, et le diamètre des pièces, et par les divisions décimales, devrait leur être conservée. Mais, l'unité actuelle dans ce pays, le *franc* (équivalant à 18 *cents* 7 *mills* des monnaies américaines) *est trop petite*. Heureusement, on a en France une pièce en argent, la pièce de 5 *francs*, de la valeur, à peu près, de notre *dollar*. Prenons la pièce de 5 francs, du poids et de l'alliage actuels; changeons-en le nom, et la divisant par fractions décimales, en *cents* et *mills*, acceptons les monnaies françaises, avec les poids et mesures français, *en la déclarant l'unité monétaire*. Ce changement de l'unité n'altérerait point les rapports qui existent entre les monnaies et le système métrique. Quel sera le nom de la nouvelle unité ? Il ne devrait être ni *dollar*, ni *franc*. Ces noms, appartenant déjà à des unités

from that proposed to be established, either of those names would create a confusion of accounts as well as of ideas that should be avoided. Besides, those names have a character of nationality, that might be seized upon by national prejudices, and become ground of refusal, or of delay in the universal adoption by all civilized nations of one and the same system of weights measures and money. Let us make a name for the new five-franc unit, as the French have already made names for the other units, free from all these objections. And for this purpose let us again apply to the *ancient Greek*. Let us take the old greek silver coin στατηρ (*stater*) and make it the name of the new unit. It may be adopted without any change, *stater*: or, analogizing it to the already adopted names, it may become *statre*, or better still, entering, thus, perfectly into the modification of the nomenclature of the system which I have recommended above it would become *statt*. We should thus have the three denominations of money — *statre, centistatre, millistatre* — to annex to the five series of weights and measures, described in the 2nd of the amendments to the system which I have above proposed: each series, *composed of three denominations only*, except that of long measure, of which the two extremes, the two supernumerary terms, millimetre, and myrimetre, are retained for scientific purposes. It would be well perhaps to add to the monetary denominations *Decastatre* (10 statres) for the expression of very large sums. But I would urge the adoption of the modified nomenclature suggested in the 1st of my above amendments. *It belongs to no modern language*, while the actual names of the units have a french air that might render them unacceptable to certain other nations. *Its terms are shorter*: and therefore more convenient for use. *There would exist among all nations a hardly appreciable difference of prononciation.* This is a capital quality in a system proposed for universal adoption. If their beautiful and admirable system were adopted by us as a whole, the French themselves, would doutbless accept some, or all of our modifications, and all other nations would soon follow.

I remain respectfully your friend, and obedient servant.

WILLIAM W. MANN. (of Georgia)

N. B. Messrs Silbermann and Durand have given minutely in their able Reports, which I am told are to accompany your letter to the chairman of the committee of commerce, all purely scientific informations relative to the weights, measures, and coins of France, that could be desired. It has been my aim in the foregoing remarks, to give a plain, practical description of the metrical decimal system, for the perusal of plain, practical men. And to this end, I have avoided all scientific details that were not necessary to the elucidation of my subject. Permit me, with the same view, to add to my letter, a sheet of drawings or engravings which will present to the eye of the reader with sufficient exactness for my purposes, the form of the weights, measures, and coins of France, and of other instruments, in common use, under the system. W. W. M.

monétaires bien connues, dont l'usage est journalier, et différentes en valeur de celle proposée à l'adoption, ils produiraient, l'un et l'autre, une confusion regrettable des comptes et des idées. De plus, ces noms portent un caractère de nationalité, dont peut-être s'empareraient les préjugés nationaux, pour devenir, dans la suite, un motif pour refuser ou ajourner l'adoption, par toutes les nations civilisées, d'un et même système de poids, mesures et monnaies. Trouvons un nom pour la nouvelle unité, la pièce de 5 francs, comme les Français en ont trouvé pour les autres unités, auquels ces objections ne pourraient pas s'adresser. A cette fin, cherchons encore dans l'*ancien grec*. Nous pourrions prendre le nom du στατηρ, stater, ancienne pièce de monnaie en argent, pour le donner à la nouvelle unité. L'on pourrait l'adopter, sans changement, *stater* ; ou, lui faisant subir la modification appliquée aux noms déjà adoptés, il deviendrait *statre* ; ou mieux encore , le faisant ainsi rentrer dans la nouvelle nomenclature que j'ai proposée ci-dessus, il deviendrait *statt*. Nous aurions alors les trois divisions monétaires — *statre*, *centistatre*, *millistatre* — à ajouter aux cinq séries des poids et mesures énoncées dans le second des amendements que j'ai suggérés plus haut. Chacune de ces séries se compose de *trois divisions*, excepté celle des mesures de longueur, dont les deux termes extrêmes, les termes supernuméraires, *millimètre* et *myrimètre*, sont gardés pour les besoins scientifiques. Il serait bien peut-être d'ajouter *décastatre* (10 *statres*) pour exprimer de grandes sommes d'argent.

J'insisterais sur l'utilité qu'il y aurait à adopter la modification de la nomenclature dont j'ai parlé dans le premier des amendements que j'ai proposés. Les nouveaux noms *n'appartiendraient évidemment à aucune des langues modernes*, pendant que les noms actuels ont un *air français*, qui serait, peut-être, mal vu de certaines autres nations. *Les mots sont plus courts*, et, par conséquent, plus commodes. *Il y aurait dans toutes les nations une diversité de prononciation, à peu près nulle.* C'est un mérite capital dans un système destiné à l'adoption universelle. Les Français eux-mêmes, si leur beau et admirable système était adopté comme un tout par les Etats-Unis, accepteraient sans doute quelques-unes sinon toutes nos modifications et les autres nations nous suivraient de près.

Je reste respectueusement votre ami et serviteur obéissant,

WILLIAM W. MANN.

MM. Silbermann et Durand ont donné minutieusement, dans leurs remarquables rapports, qui, doivent être joints à votre lettre, adressée au président de la commission du commerce, tous les renseignements, purement scientifiques, relatifs aux poids, mesures et monnaies, que l'on pourrait désirer. Mon but à moi, dans les lignes qui précèdent, a été d'écrire une description simple et pratique du système métrique décimal, à la portée de tous ceux qui savent lire. A cet effet, j'ai évité tous les détails scientifiques qui n'étaient pas nécessaires pour bien expliquer le système. Permettez-moi, dans la même intention, d'ajouter à ma lettre une feuille de gravures qui présentera à l'œil du lecteur, avec un degré suffisant d'exactitude, les formes des poids, mesures et monnaies de France, et des autres appareils en usage appartenant au système. W. W. M.

REPORT [1]

ON THE OPERATIONS EXECUTED

BY ORDER OF

GENERAL A. MORIN

Member of the Institute, Professor-Director of the Conservatoire des arts et métiers

FOR THE VERIFICATION

OF THE STANDARD WEIGHTS AND MEASURES

Presented by France to the United States

DRAWN UP BY

M. J.-T. SILBERMANN

Superintendent of the Conservatoire des arts et métiers

And translated from the French

BY

Mr Hippolyte VATTEMARE.

The verification of the standards of weigths and measures presented by the french Government to the Government of the United States has been made at the Conservatoire des Arts et Metiers, in the gallery of weigths and measures of that establishment, and with the prototypes of commerce deposited there.

The very prototypes hab been previously compared with the official prototypes deposited in the Archives of France. Here are, at first, the results of that comparison, as well as the manner in which they have been obtained.

The two series of prototypes of commerce and of the Archives consist each in one metre with *ends*, in platinum, and in one kilogramm of cylindrical form, likewise in platinum.

These measures were made at the same time by the celebrated artists Lenoir and Fortin, and verified by their colleagues of the international Commission of weights and measures, in the year 7 of the Republic (1799).

(1) Messrs Silberman and Durand's reports having already been published in french by the *Société d'encouragement*, in its Bulletin number of August 1853, and as this Bulletin has an immense circulation, we though useless to reproduce them here.

The comparison of the metre has been made by means of a special comparator, which indicates a ten thousandth of millimetre, viz. $\frac{1}{10,000,000}$ of the fondamental length.

For the comparison of the kilogramm, a balance was used which indicated the half milligramm. Compensation has been made for the loss which these weights sustained in the, air a loss determined by means of a comparator constructed with the view of ascertaining the lineal dimensions of those cylindrical weights.

There exists no prototype of measures of capacity; in fact, this is not necessary, the unit of this prototype, the litre, being a cubic decimetre, and a cubic decimetre of distilled water, taken at its maximum of density, weighing precisely one kilogramm *in vacuo*.

Accordingly, the kilogramme takes the place of that unit.

The collection of the standard weights and measures given to the United States in exchange for those presented by Mr Vattemare consists in three various series, viz :

1° One standard metre in steel, on a bronze basis, and one standard kilogramm in gilt brass.

2° One graduated metre, in brass, and one litre, both made by Gambey;

3° The series of weights and measures composing the suit of a bureau of verification of the first class; finally, the instruments for measuring and stamping necessary to those bureaus.

CHAPTER I.

COMPARISON OF THE MEASURES OF LENGTH.

§ 1er. Comparison of the prototype metre of Commeree with that of the Archives of State.

This comparison has been made by means of my lever comparator constructed under my direction by Mr Brunner.

The accuracy of the comparisons being subordinate to the precision of the instruments of verification, I will give here a complete description of this comparator, as well as of the manner in which it has been used.

1st COMPARATOR.

Two metallic rules *aa' bb'*, of the same width, and of a length almost identical, perfectly finished, superposed and invariably fixed in *c'* are the

basis of the comparator. The inferior rule bb' is of bronze, and the superior one aa' of platinum; their common breadth is 30 millimetres; the other dimensions are the following :

Platinum rule, 1^m 12 length, 3^{mm} 5 thickness.
Bronze — , 1^m 13 — 7^{mm} —

Two heels fixed at the extremities of the apparatus serve as a matrix for the metre to be interposed. These two heels are formed by the extremities dd' of the small arms of the two levers de, $d'e'$, the axles of rotation f, f' of which are strongly attached to the inferior rule, and which by their great arms amplify the small differences of length that may exist in the metres interposed between the arms.

The small arm of these levers is 8 millimetres in length, the great arm, 160 ; their position is vertical above the rules to which they are fastened by the support of their axle of rotation. This axle itself revolves between two screw points secured by the support.

The lever $d'e'$, which is by the side of a', where the two rules are fastened, is used as a knocker for the measures to be compared ; accordingly, the position of its axle of rotation is invariably fixed on the rule.

The other lever de is used to effect contact; for this purpose, it is attached to the frame $g\ h\ i$, which holds a micrometer-screw, the nut k of which is fixed upon the bronze rule by means of an upright uniting the two pieces.

In order not to injure the extremities of the interposed metres, those two levers have been rested against these extremities only by means of the pressure of a small spring ll', the power of which does not exceed 5 grammes. The end dd' of a small arm is bent forward ; it is cylindrical, horizontal and is provided with an edge of 2^{mm} in length which serves as point of contact.

As the contact is to be operated only in a single position of the levers there has been drawn an invariable guide-line or mark upon the top mm' of the support of each of the levers. This guide-line must coincide with the guide-line drawn upon the end of this lever. In order to give to this coincidence the necessary precision, five lines, instead of a single one, have been drawn both on the lever and the support. In operating experiments, it is the two centre lines that must be made to coincide. The other lines are nearly equi-distant ; but those drawn upon the end of the lever are a little less far apart from each other than those which are drawn upon the support.

By means of this contrivance, these lines perform the office of a vernier. The coincidence of the centre lines becomes thus more perfect, and its precision is increased by furnishing each support with a magnifying glass nn'. A derangement of $\frac{1}{10,000}$ of a millimetre at the points of contact of the small arm of the levers d and d' is thus indicated at the extremity of the great arms by half a division of the vernier : a quantity quite discernible by means of the magnifying-glasses.

It may easily be understood that these delicate coincidences could not be operated by the hand ; they are performed by the pincers p, which grasp the measure on both sides; these pincers are terminated by an horizontal tail-piece q, which holds a recalling screw r with very close grooves, which inserts itself into the foot of the support. This screw is placed in the prolongation of the superior surface of the platinum rule upon which lies the standard to be compared.

The groove of the micrometer screw *s*, which constitutes the measuring apparatus properly called, is precisely of one half millimetre. The head or drum *t* of this screw is divided into 500 parts subdivided in 5,000 by a vernier at the 10th *v*, fastened to the slide of the screw. The millimetre is thus subdivided in 10,000 parts, which brings to ten millionths of mètre, viz. to the relation of the metre to the quarter part of the terrestrial meridian.

This screw, perfect in its construction, runs between two points fixed by screws in the frame supporting the lever of contact; it is in the prolongation of the points of contact.

The delicacy of the contacts as well as that of their estimation being ascertained, there remains one condition yet to be accomplished, viz the invariableness of the distance between the two heels, invariableness constantly troubled by the changes of temperature on account of the dilatation or of the contraction that these thermometrical variations cause to the bronze rule which is the basis of the levers, as we said before.

To ascertain with exactitude its value, as well as its invariability, that basis carries a platinum rule, the dilatation of which , different from that of the bronze rule, enables one to use these two rules as a thermometre of Borda, which indicates, at every instant, the temperature of the apparatus. It is for this reason that the two rules are connected at one of their extremities by an axle *c'*, which passes through them, while being free at the other end, they can dilate according to the temperature. The difference of dilatation is indicated by a graduation *c* in 1/4 of millimetre, drawn on that end on the platinum rule; with this graduation corresponds a vernier *v'*, dividing 24 of those quarter millimetres into 25 parts, forming thus hundreths of millimetre on the vernier placed on a plate of platinum fixed to the bronze rule. This plate serves, at the same time, as a guide to the platinum rule; while the foot of the nut of the micrometer-screw directs the rule to the other border.

As this precision is not sufficiently delicate, compared with that of the levers, a lever *d''f''e''*, similar to the two former ones, has been adapted to the extremity of these rules; the axle *f''* of this lever has the same movement that the end of the bronze rule to which it is fixed, while the contact of the small arm is pressed by a spring against the vertical extremity of the platinum rule and, consequently, moves with it.

The great arm *f''e''* of this lever is terminated by an arc of a circle *e''* upon which is drawn a wide vernier very minutely graduated, which can run over an other graduated arc of a circle *m''*, the foot of which carries the axle *f''* of the lever fixed to the bronze rule. The dimensions of this vernier permit the appreciation of $\frac{1}{50\text{th}}$ of a degree of temperature.

The delicacy of these indications corresponds therefore with that of the two other levers.

This comparator is supported at short intervals upon sills or guides *y* of the same thickness, being themselves laid upon a cast support well dressed *zz'*.

The following experiments, executed first with the prototype of the Archives and with that of commerce, then with the measures presented to the United States, will serve at the same time as a guide for the use of the apparatus just described.

2° COMPARISON OF THE PROTOTYPE OF THE COMMERCE WITH THAT OF THE ARCHIVES.

Those two metres, both in platinum, constructed at the same time, and deposited, one in the Archives of the State, Messidor 4, an. VII (June 22, 1799), the other in the department of the interior, previously verified by the same operation, have been found identical at the temperature of 10° and after 24 hours of sojourn side by side.

I did not take the liberty of icing the prototype; besides, the slight coefficient of dilatation of the platinum allowed to admit that there would be no appreciable difference between these two metres at the legal temperature of 0°.

One of these metres may therefore, whithout any scruple, be taken for the other; what I have already done in the comparison of a prototype destined for Spain.

§ 2. Construction of a standard metre of the United States and determination of its coefficient of dilatation.

This standard metre aa' is in steel; it has been rebaked in a fire of charcoal, that was left to die off as slowly as possible; it was afterwards dressed with the planing-machine without being hammered nor filed, then rubbed with emery in order to finish it on its four faces; finally, it was cut to the metrical length, at the temperature of melting ice, by means of a standard at the same temperature. The two ends were adjusted, rubbed and polished by M. Brunner with the aid of a process of his own.

That standard metre of the United States is, at the same time, *à bout* and *à trait*. It is *à trait*, because on each end has been screwed a small *prisure* in steel dd'; in order to render the joint obvious, a golden plate of one 100° of millimetre of thickness has been inserted between the *prisure* and its extremity.

Placed upon a thicker bronze rule bb', similar to that of the comparator, it forms, with this, a Borda-thermometre; both are united at one of their ends a' by a conical centre c', like the two rules of the comparator; the axle of this centre is at 23 millimetres of the extremity of the metre.

The two other ends a are free in their movement of dilatation; each ones carries a graduated scale; the scale belonging to the bronze rule is engraved on a silver wire f, screwed on that rule; its division are fourths of millimetre. The vernier l is fixed on the steel rule; it is made of a small silver plate sunken into the face of the rule; it gives 25ths of the opposite division, viz, hundreths of millimetre.

The 0 of this vernier is at 954 millimetres from the axle c.

Opposite to the graduated bronze plate, on the other side, in g, is a brass plate of the same size; these two plates serve as guide to the free extremity of the steel metre.

A vernier l', and a graduation on silver f', as well as a brass guide g', similar to the former, are to be found at the fixed extremity a'. This second graduation would be used in case the axle would become loose, which loose-

ness would immediately be detected by the change of coincidence between the two graduated scales placed on that end.

1° DIFFERENCE OF DILATATION BETWEEN THESE TWO RULES.

This apparatus of rules was placed in melting ice, where it was kept during two hours; the coincidences having become invariable at the end of that time, the measures were as follows :

The vernier of the fixed end indicated..... 4^{mm} 88.
That of the free end..... 4^{mm} 42.

After remaining two hours more in boiling water the following numbers were furnished :

For the vernier of the fixed end..... 4^{mm} 88.
For that of the free end..... 3^{mm} 80.

Difference between the free ends 4^{mm} 42—3^{mm} 80=0^{mm} 62.

The difference of dilatation, from 0° to 100°, between the two metals, steel and bronze, which constitute the two metres submitted to experiment is, therefore, of 0^{mm} 62 for 100°, and for a length of 954^{mm}, distance from the axle or fixed point to the 0 of the vernier placed at the free end.

2° ABSOLUTE DILATATION OF THE TWO RULES.

In order to determine the absolute dilatation of each rule, I was obliged to invent a special process which allows to carry ,effectively, an invariable length on each one of the rules, at every one of the normal temperatures from 0° to 100°.

The instrument, by means of which an invariable length is inscribed on the rule, is a compass *à verge*, with very strong hard points, and constantly kept in a wooden trough full of melting ice.

The compass consists in a steel rule *aa'* : length, 1^{m} 20; breadth, 5 centimetres, and thichness about 8 millimetres; it carries two dry points *bb'*, screwed at a distance of one metre from each other. These points are of tempered steel and very strong ; their ends are turned and sharpened with great care and they present a cone, the opposite *genatrixes* of which form an angle of about 60°. The distance between the two apexes of the cone is $\frac{1}{200}$ of millimetre shorter than the metre submitted to melting ice.

The trough in which this compass is placed is of a triangular shape, one of the edges forms the basis in which two holes have been made for the passage of the points of the compass, so that these points might project about 15 millimetres.

While the compass is immersed in melting ice, the rule to be experimented on is also immersed in melting ice. The trough destined to receive the rule is furnished with a cast support well finished in its whole length, destined to receive uprightly the rule upon which you operate. Two hours after this immersion, the rule has attained a temperature that may be considered as uniform and invariable.

Then, in order to mark this rule with the compas, the extremities are lightly uncovered, and the trough containing the compass is placed close by, so that the tips be only at one millimetre from the surface of the rule; then, slightly pressing one of the tips upon the rule, with the other you describe an arc of circle of one or two millimetres in length, the tip is arrested at the extremity of this arc; and from that point as centre an other arc is described with the corresponding tip at the other extremity of the rule.

After this first pointing, the compass is put aside and the rule with its support is placed in a metal trough full of distilled water the temperature of which is raised to the boiling point by means of alcool lamps. After two hours of ebullition, a second pointage is effected. This operation is similar to the first one; but care should be taken to press the first tip within the mark traced in the former pointage and at about one half millimetre from this mark; then, the other tip will likewise fall within the other mark and very near to it. The two last marks will therefore be placed between the two former ones, and will likewise consist of two arcs of circle; this precaution has been omitted here, for the first tip has been carried outside; accordingly this position must be subtracted from the other.

Thus, are obtained four marks corresponding two by two to the temperatures 0° and 100°.

When the pointage is finished, the distance between the arcs of circle obtained at the two extreme temperatures is measured by means of the micrometre and of the microscope 0 of the comparator.

The distance between the two marks of the free end of the bronze rule has thus been found te be 2^{mm} 2459, and the distance corresponding to the interval of the arcs of the fixed end, 0^{mm}5429; this last distance is negative.

The absolute dilatation of the bronze rule is therefore 2^{mm} 2459 — 0^{mm} 5429 = 1^{mm} 7030.

The distance taken with the micrometre between the two marks of the free extremity of the steel rule is 1^{mm} 6080; the distance of the fixed extremity is 0^{mm} 5578, which is a negative one; the absolute dilatation of the steel metre is therefore, from 0° to 100°, 1^{mm} 6880 — 0^{mm}5578 = 1^{mm}0502.

3° COMPARISON BETWEEN THE DIFFERENCIAL DILATATION AND THE ABSOLUTE DILATATION OF THE TWO RULES.

These two modes of experiments have taken place simultaneously.

The dilatation of the bronze having been of.....	1^{mm} 7030
that of the steel metre of.....	1^{mm} 0502
we have had for one metre the difference.....	=0^{mm} 6528
which, for 0^{m} 954 distance of the vernier, gives.....	0^{mm} 6228

This quantity is confirmed by the reading 0,62 given in the first place, reading made, as is known, to the hundreth of millimetre.

According to the preceding data, it is easy to establish the coefficient of correction for any temperature, by means of the reading of the two divisions marked on the extremities of the steel metre.

Say c, the variation or actual difference with the metre at 0°;

l, the difference between the two verniers at t° for the temperature c;

l', the difference between the two verniers at 0° for the exact metre,

We will have $e = (l - l') \times \frac{1{,}7030}{0{,}6228}$

For example, in the case of boiling water at 100°, we have had, at 0°, the fixed vernier 4^{mm} 88, at 100°, the fixed vernier 4^{mm} 88.

The free vernier $\frac{4.42}{l' = 0.46}$ the free vernier $\frac{3.80}{l = 1.08}$

We had therefore $e = (1{,}08 - 0{,}46) \times \frac{1.70}{0.62} = \frac{0.62 \times 1.70}{0.62} = 1^{mm}\,70$

This metre has therefore been found $1^{mm}70$ longer at $t°$ than at 0°.

Should we desire to ascertain the temperature of the apparatus, we would have $t = \frac{(l - l')}{0.0062}$

If, in any experiment, the coincidence did not take place, at the fixed extremity, under the figure 4,88, for example, the centre becoming loose, it would suffice to carry the new indication, in the first place, in the values l and l', or to add its difference with 4,88 to $l' - 0{,}46$, if the new number is smaller than 4,88, or to subtract it, in the contrary case.

Thus constituted as a Borda-thermometre, this metre offers the advantage of being easily reduced to 0° by the reading of the verniers, or, of giving the quantity to be added to the absolute metre, in order to have a standard measure at every temperature. By the movement or the stopping of the verniers, you perceive also if the temperature is fixed. Finally, the standard is faithfully *à bout* and *à trait*.

4° COMPARISON BETWEEN THE STEEL METRE AND THE PROTOTYPE OF THE CONSERVATOIRE DES ARTS ET MÉTIERS.

The comparison has been made at melting ice, while the preceding dilatation was determined upon the comparator also at melting ice.

The moment the levers became invariable, the reading of the micrometrical screw gave :

For the platinum prototype.....	0^{mm} 5219
For the steel prototype.....	0^{mm} 4993
The steel metre is therefore too short of.....	0^{mm} 0226

Its legal value, at melting ice, is therefore of :

$$1^{m} - 0^{m}\ 0000226 = 0^{m}\ 999977\text{4}.$$

§ 3. Comparison of Gambey's brass graduated metre.

This metre was compared at the same time as the preceding ; its length at 0° is

$$1^{m}\ 0002992.$$

It bears inscribed its coefficient of dilatation which has been determined by Gambey ; I have not therefore verified it.

Brass graduated metre (for the Bureaus of verification).—This metre has been stamped in the Bureaus of the verifiers; it is, therefore, in the legal limits of exactitude.

The wooden metre is also stamped and, therefore, in the legal limits of exactitude.

CHAPTER II.

COMPARISON OF THE WEIGHTS.

§ 1er. Comparison of the platinum standard kilogramme of the Archives of State with the standard kilogramme of commerce, likewise in platinum, deposited in the Conservatoire des Arts et Métiers.

These two weights have been compared in open air on a scale canting at half a milligramme; they must, accordingly, be corrected of the differences of the weight of the volume of air they deplace at the moment of the operation.

The determination of the volume of these two kilogrammes was effected by means of an instrument made expressly by Gambey, which is exact at nearly one hundreth of millimetre, and used to determine the heights and diameters of these cylinders. The result of the operation has proved that their height is perceptibly equal to their diameter. The average measure, after a long series of operations, has given for the volume :

Prototype of the Archives.....	48,6973	cubic centimetres.
And prototype of the Conservatoire.....	52,3220	—

Weight of 1 litre or 1000 cubic centimetres of air.

The barometer marked 754^{mm} or at 14°9; hence $H_o = 752^{mm}\ 17$, the condensing hygrometer gave the point of dew at 9°7; hence $f = 9^{mm}\ 305$, for the elastic strength of the vapour contained in the air.

The temperature of the air was 15°7.

Pression of dry air $=752.17-9.305=742.865$ } at the temperature
— of the vapour in the air $= 9.305$ } of 9° 07.

1 litre of dry air at 0° under normal pressure of 760^{mm} weighs $1^{gr}\ 2991$
1 litre of vapour at 0° — — should weigh $0^{gr}\ 80559$

(Nota. This weight of the vapour at 0° under the pressure of 760^{mm} is

deducted from its weight at 100° under the same pressure, which weight is 0gr 58948, corrected afterwards of its contraction from 100° to 0° by the coefficient of the dilatation of the air, which, for 1gr, is 0.00366).

1 litre of dry air under 742mm 865 and at 9°7 weighs therefore

$$\frac{742{,}865 \times 1^{gr}\,2991}{760 \times (1+0{,}003666)+9.7} = 1^{gr}2248 \ldots\ldots\ldots\ldots \quad 1^{gr}2248$$

and 1 litre of vapour under 9mm 305 and at 9°7 weighs

$$\frac{9{,}305 \times 0{,}80559}{760+(1+0{,}003666)\times 9.7} = 0^{gr}0095 \ldots\ldots\ldots\ldots \quad 0^{gr}0095$$

Therefore, 1 litre of moist air under 752mm 170 and at 9°7 weighs 1gr2343

The weighings having been effected at 15°7, the preceding weigh is too great by a quantity corresponding to the increase of volume that this weight of the air experiences in passing from 9°7 to 15°7. We have therefore at 15°7 the weight of 1 litre of moist air $\frac{1{,}2343}{1+0{,}03666\times(15.7-9.7)} =$ = 1gr2077

1 litre or 1000 cubic centimetres weighing 1gr2077, 1 cubic centimetre weighs 0.0012077.

Weight of the volume of air displaced.

P, the prototype of the Archives displacing 48cc6973 of air, the correction is

$$48^{cc}6973 \times 0^{gr}0012077 = 0^{gr}05881.$$

P' the prototype of the Conservatoire displacing 52cc3220 of air the correction is

$$52^{cc}3220 \times 0^{gr}0012077 = 0^{gr}06319.$$

The average weighing has given, for equilibrium in the air,

$$P' + 0^{gr}001 = P.$$

If the balance thus poised in the air was carried in vacuo, the equilibrium would be destroyed; the body that has the more volume experiencing the greater loss in the air, would gain more weight in passing from the air in vacuo, it would therefore cause the scale to cant on its side according to a weight precisely equal to the difference of the weight of the air previously displaced by each of them.

Substracting therefore from each one of these weights its loss in the air, in order to restore the equilibrium in vacuo, which is equivalent to subtracting from the larger the difference of the two losses, we shall have for equilibrium in vacuo

$$P' + 0^{gr}001 - 0^{gr}06319 = P - 0^{gr}05881;$$

Hence $P' = P - 0^{gr}05881 - 0^{gr}001 + 0^{gr}06319 = P + 0^{gr}00338$.

As $P = 1000^{gr}$

$$P' = 1000^{gr} + 0^{gr}00338 = 1000^{gr},00338.$$

§ 2. Comparison of the standard kilogramme in platinum of Commerce with the gilt brass kilogramm of the United States.

All the operations of weighing have been effected with the two scales presented to France by the Government of the United States.

These scales are both sensible to the $0^{gr}0005$ with a load by basin of 1 kilogramme for the smaller, and of 10 kilogramms for the larger.

In order to keep up this sensibility and to avoid the alterations it could experience in the changes of weights, it is necessary to leave the scales in suspension with their loads, then to stop the basins underneath by means of the small handle fixed to them for that purpose, and, at the same time, to press in a fixed manner on the basin used for the weighings, so that this basin experience no variation in its suspension; it is then only that the weights may be changed, after which the pressure above is removed, as well as the handle in order to leave the scale free.

These minute precautions are indispensable, not to be exposed to commit errors of 20 to 30 milligramms on the large scale, and of 5 to 6, on the small one.

The former platinum weight P' has been used in the comparison of the gilt brass kilogrammes executed by Gambey for international exchanges, between which is comprised the n° 6, destined for the United States.

The volume of this n° 6 is deduced from the volume of water it has displaced at the temperature of 12°.

(Nota. It has been ascertained that the button, strongly screwed, has not allowed any water to penetrate in the interior, nor even in the joint).

The weight of water at 12° displaced $= 123^{gr}945$;

The volume of this brass kilogramme is, therefore, according to Despretz's table $\frac{123,945}{0,999,634} = 123^{cc}9903$.

These corrections, rendered indispensable by the loss of weight in the air, have been executed by means of the following observations made during the weighings;

The barometer was at $760^{mm}60$ at 13°1, hence $H_o = 758^{mm}99$;

The hygrometer, dew at 4°5; therefore $f \ldots\ldots = 6\ 74$;

Therefore the pressure of dry air $= 758^{mm}99 - 6^{mm}74 = 752\ 25$.

The temperature of the air $= 13°1$.

hence 1 litre of dry air, under 752^{mm} 25 and at 4°5, weighs

$$\frac{752,25 \times 1,2991}{760 \times (1+0.003666) \times 4.5} = \ldots\ldots\ldots\ldots\ldots\ldots\ 1^{gr}2691$$

and 1 litre of vapour under 6^{mm} 74 and at 4°5, weighs

$$\frac{6.74 \times 0,80559}{760 \times (1+0,003666) \times 4.5} = \ldots\ldots\ldots\ldots\ldots\ 0^{gr}0070$$

hence, 1 litre of moist air, under 758^{mm} 99 at 4°5, weighs..... $1^{gr}2761$

The weighing having been made at 13°1, the preceding weight is too great by a quantity corresponding to the excess of dilatation experienced by the volume of air while passing from 4°5 to 13°1, viz. for 8°6.

We have then at 13°1 $\frac{1,2761}{(1+0,003666)\times 8.6} = 1^{gr}2492$ for the weight of 1 litre of air, and consequently 1^{cc} of air weighs $0^{gr}0012492$. The prototype P' looses therefore, of its weight, $52,3220 \times 0,0012492 = 0^{gr}06536$, and the kilogramme n° 6 in brass, $123,9903 \times 0,0012492 = 0^{gr}15489$.

The comparison of those two kilogrammes having been made in the air, it is necessary, in order to bring it back to what it would be in vacuo, to substract from each one the loss it has sustained in the air. The double weighings of the n° 6 have given the following results :

$$N° 6 + 0^{gr}1320 = P' + 0^{gr}0420;$$

introducing the correction to bring back to vacuum, we have;

$$N° 6 + 0^{gr}1320 - 0^{gr}15489 = P' + 0^{gr}0420 - 0^{gr}06536;$$

hence n° $6 = P' + 0^{gr}0420 - 0^{gr}06536 - 0^{gr}1320 + 0^{gr}15489 = P' - 0^{gr}00047$;
Replacing P' by its value, viz. 1000,00338, we have

$$N° 6 = 1000^{gr}00338 - 0^{gr}00047 = 1000^{gr}00291.$$

All the kilogrammes which have served for the comparison have been verified, and they have given in vacuo the following results, submitted besides to a direct verification :

the N° 1		1000,gr 00291
N° 2		1000, 00690
N° 3		1000, 00890
N° 4		1000, 00590
N° 5		1000, 00990
N° 6		1000, 00291

§ 3. Direct comparison in vacuo of the pneumatic machine, between the standard kilogramme of commerce and the gilt brass kilogramme n° 1 of the preceding series.

This comparison has been heretofore tacitly deemed impraticable; at all events it has not been undertaken. The method pursued in operating this comparison fulfils perfectly its end; it had not been definitively adopted at the time I had to compare the kilogramme destined for the United States; but that kilogramme is identical with n° 1 which is used here as standard of comparison. This method is besides very simple in practice, and secured from the effects of temperature, pressure and hygrometry, as well as from the variations produced in the differences of volumes or densities.

Two small glass receivers a and a' offering precisely the capacity necessary for containing a brass kilogramme k, equal besides in volume (0 lit. 2) and in weight, are provided at their summit with a small cock; each receiver is placed upon a rough glass disk which serves as movable plate.

The cementing between the receiver and the disk is made by means of the process of Mr Poinsot, chemist at the Conservatoire des Arts et Métiers; it consists in covering the edge of the receiver with a strip of vulcanised India rubber, which has been deprived of its exces of sulfur by a potash washing; this strip, stretched round the edge, passes over the later in order to interpose between it and the plate. The vacuum is perfectly maintened, if the strip is thin enough.

The standard kilogramme *P* being placed under one of the receivers, and a kilogramme used as tare having been placed under the other, the vacuum is made in the two receivers at the same time, and dry hydrogen is introduced in them before making the definitive vacuum. After the hydrogen has been expelled by the air-pump, the remaining pressure has stopped at 2 millimetres; the weight of the hydrogen that remains in each receiver, under this pressure, is inappreciable by the scale, and, besides, the weight to be considered is but the difference of the weight of the volumes displaced, weights inferior to the preceding, which is itsef only $\frac{0^{lit}2 \times 0^{gr}0898 \times 2^{mm}}{760^{mm}} =$ $=0^{gr}000047$ or about 5 hundreths of milligramme.

The two receivers emptied of air have been placed respectively upon one of the basins of the scale.

After having established very exactly the equilibrium with some small weights, I took off the receiver containing the platinum prototype and I replaced the later by the kilogramme n° 1; I operated the vacuum in the same way as before, and above all I reduced it to the same degree of interior pressure.

Replacing the receiver in this state upon the basin of the scale, I obtained an equilibrium after having placed one half milligramme in the basin that sustained this receiver.

This last result agrees perfectly well with what has been obtained by the ordinary corrections, in order to reduce the weighings in the air to those effected in vacuo.

In fact, the weight of the prototype has been found...	=	$1^{k}000^{gr}00338$
The weight of the kilogramm n° 1.....	=	1,000.00291
Difference between these weighings in the air.....	=	0.00047
And finally, difference between these weighings in vacuo.	=	0.00050

This identity between these two differences confirms, at the same time, the first operations and the process of verification just described.

§ 4. Comparison of the standard weights of the case destined for the United States with the preceding kilogrammes taken as standard.

I have supposed that all the brass weights were of the same density as the preceding; and as, in this case, they are equilibrated in the air and in vacuo, their volume of displaced air being the same, I have not applied to these weights the loss they experience in the air; their value is therefore that which they have in vacuo.

The series of standard weights is composed as follows :

A weight of	20	kilogrammes.....or	20,000	grammes.
id.	10	—.....	10,000	—
id.	5	—.....	5,000	—
2e id.	2	—.....	2,000	—
1er id.	2	—.....	2,000	—
2e id.	1	—.....	1,000	—
1er id.	1	—.....	1,000	—
id.	5	hectogrammes.....	500	—
id.	2	—.....	200	—
id.	1	—.....	100	—
id.	1	—.....	100	—
id.	5	decagrammes....	50	—
id.	2	—.....	20	—
id.	1	—.....	10	—
id.	1	—.....	10	—
id.	5	grammes.....	5	—
id.	2	—.....	2	—
id.	2	—.....	2	—
id.	1	—.....	1	—

1000gr.

Fractions of the kilogramme.

			gr	
A weight of	5	decigrammes.....	0.5	
id.	2	—.....	0.2	
id.	1	—.....	0.1	
id.	1	—.....	0.1	
id.	5	centigrammes.....	0.05	
id.	2	—.....	0.02	
id.	1	—.....	0.01	1gr.
id.	1	—.....	0.01	
id.	5	milligrammes.....	0.005	
id.	2	—.....	0.002	
id.	1	—.....	0.001	
id.	1	—.....	0.001	
id.	1	—.....	0.001	

We have begun by verifying each weight of 1 kilogramme, then the weights of 2 kilogrammes, then those of 5 kilogr., of 10 kilog., of 20 kilog.; the multiples of the gramme, from 1 gramme to 5 hectogrammes, making together 1,000 grammes, have been compared to the 1 kilogr. only. The subdivisions of the gramme, forming together 1 gramme, have been compared to the 1 gramme.

The double weighings have given the following gross results :

The n° 1 of the 1 kilogr. = n° 6 + 0g0040 = 1000g0029 + 0g0040 = 1000g0069
2 1 = n° 6 + 0.0020 = 1000.0029 + 0.0020 = 1000.0009
1 2 = n° 6 + n° 1 — 0g076 = 2000g0058 —
— 0g076..... = 1999.9298

The n° 2 of the 2 kilogr.=n° 6+n° 1—0.064=2000.0058—
—0.064.....=1999.9418

5 =n° 2+n° 3+n° 4+n° 5+n° 6—
— 0ᵍ020.....=5000.0145

10 =n° 2+n° 3+n° 4+n° 5+n° 6+
5000ᵍ0145—0ᵍ088.....=9999.9610

20 = les 2 $1^k+2^k+2^k+5^k+10^k$ preceding+0ᵍ040=19999ᵍ848+0ᵍ040..=19999.888

The weights of (5^h, 2^h, 1^h, 1^h, 5^d, 2^d, 1^d, 1^d, 5^g, 2^g, 2^g, 1^g) =
=n° 6+0ᵍ002.....=1000.0049

The cup kilogramme of the scale of 1 kilog.=n° 6+0ᵍ002...—1000.0049

After having been verified separately, the fractions of the gramme of the great series have been once more verified according to a gramme adjusted by Fortin; these small weights put together must make exactly the gramme; their value has been found equal to 1ᵍ00020, on a gramme balance of Devrine, made at the beginning of this century and which cants by a division of 1^{mm} of length for $\frac{1}{25}$ of milligramme; thus placed in these favourable conditions for weighing, I could easily read with the naked eye the fourths of millimetre or of division, which corresponds with hundreths of milligramme; besides, the balance has the same dispositions of handle as the balances of the United States.

§ 5. Iron weights.

The cast iron weights having been subjected by the bureau of verifiers to the ordinary verification of weights, and their accuracy being comprised in the limits prescribed by law, I have not verified them anew.

CHAPTER III.

COMPARISON OF THE MEASURES OF CAPACITY.

§ 1. Definition and correction.

The unit of the measures of capacity is the litre; it is, in relation to the metre, a cubic decimetre; now the weight of a cubic decimetre of distilled water, taken at its maximum of density, which occurs at + 4° of temperature and in vacuo, is precisely one kilogramme or 1,000 grammes.

It is under these conditions of legal connexion between the water and its

volume, that, in order to determine the capacity of a vessel, we use the weight of distilled water that this vessel can contain.

But as the material, of which the measures of capacity are made, dilates under the influence of heat, the legal condition is that their nominal capacity be exact at the temperature of melting ice or at 0°.

As the verifications are not practicable in these conditions of 0° for the vessel, of 4° for the water it contains, and the whole in vacuo, as for the weight, we are obliged to use calculation in order to reduce the practical conditions to the legal ones.

For the corrections relative to the temperature of the water, the loss of weight in the air, the hygrometrical state of the later, and the dilatation of the vessels, we consult, in the practice of the verifications, a table of corrections drawn up, by order of Government, by Mr Coriolis, member of the Institute.

This table supposes the barometrical pressure to be invariable, and at the normal height of 760^{mm}, and at 0° of temperature; the hygrometrical state of the air, at 72° of Saussure, which corresponds with 0,5 of the maximum tension of the vapour contained in the air for the temperature of the observation; the cubic dilatation of the brass of which are made the measures, the weights and the counter-weights, is supposed $= 3 \times 0{,}0000{,}2108 = 0{,}0000324$ for 1°c; finally, for the dilatation of the water, we have admitted that given by Halstrom for each degree of temperature between 0° and 30°c.

In the first column of this table is found the temperature of the water, in the second, the weight of 1 litre of water at 0°; and in the third, the corresponding losses of weight that must be put on the basin, if we have previously equilibrated 1 kilogramme in order to replace it by water.

TABLE OF THE CORRECTIONS FOR 1 LITRE.

Centesimal degrees.	WEIGHT OF 1 LITRE of water.	LOSS OF 1 KILOGRAMME of water.	Centesimal degrees.	WEIGHT OF 1 LITRE of water.	LOSS OF 1 KILOGRAMME of water.
	gr.	gr.		gr.	gr.
0	998,754	1,246	16	999,067	0,933
1	998,870	1,130	17	998,984	1,016
2	998,971	1,029	18	998,889	1,111
3	999,057	0,943	19	998,782	1,218
4	999,132	0,868	20	998,664	1,336
5	999,195	0,805	21	998,535	1,465
6	999,245	0,755	22	998,394	1,606
7	999,283	0,717	23	998,243	1,757
8	999,307	0,693	24	998,080	1,920
9	999,320	0,680	25	997,905	2,095
10	999,320	0,680	26	997,720	2,280
11	999,308	0,692	27	997,524	2,476
12	999,285	0,715	28	997,318	2,682
13	999,249	0,751	29	997,101	2,899
14	999,200	0,800	30	996,880	3,120
15	999,139	0,861			

This table guaranties an exactness of less than 5 milligrammes for the capacity of the litre, exactness that is much greater than is necessary in prac-

tice and which is even acceptable for theoretical purposes. It has been used in all the following verifications of capacities.

Mr Parent, balance-maker of the administration, makes use of a very sure process for adjusting the measures of capacity. He takes care, during their fabrication, to keep them some fractions of cubic centimetre smaller than the legal capacity, given by the transfusion of the water contained in a measure previously adjusted to the standard. The definitive adjustment is effected by the weighing of the water contained in the vessel ; now the capacity being made too small, the weight of water will be smaller than that reported in the above table. Multiplying the difference between these two weights by 8.5, approximative density of brass, we will have the weight of the brass to take off from the interior of the vessel and which occupies the place of the wanting water. As this brass is taken off with the scratcher, it is sufficient to weigh, in scrapings, about seven times the weight of the difference; for the rubbing with emery paper or any kind of polishing will almost complete the removal of the remaining, so as to come up to 8.5, and will allow the correction at a second experiment.

This experiment which is only a determination of capacity, is made as the one that will be used for the litre.

§ 2. Verification of the capacity of the brass standard litre.

The brass standard-litre, executed by Gambey, covered with its rough glass disk, upon which is a standard kilogramme n° 6, and the additional weight $0^{gr}792$ in one of the basins, equilibrates the other basin loaded with a similar litre covered with its disk and with 1 kilogramme.

Unloading then the first basin, replacing the kilogramm n° 5 by distilled water powered in the litre, taking care to remove with a feather the air bobbles adherent to the inner sides of this measure, you take the temperature of this water, at 12°2, then you pass the glass disk over the edge of the vessel, with the precaution of removing by sucking through a small pipe the excess of liquid in order to prevent it from running over ; avoiding always the heating by the hands; after which the measure thus prepared is placed upon its plate. Now, according to the preceding table, the cubic decimetre or litre of water, in brass, weighs, at 12°2, only $999^{gr}2778$, or its loss is of $0^{gr}7222$: after having added this loss to complete one kilogramme (weight of the litre of water at 4°) it has been necessary to add $0^{gr}863$ more in order to complete the equilibruim, which indicates that this measure is of too small a capacity.

You have, for determining this capacity, the following quantities which are equal in weight :

$$1000^{gr}00291 + 0,792 = \text{water} + 0,7222 + 0,863$$

hence you found for the weights of the water at 4° contained in this measure;

$$\text{Water} + 0,7222 = 1000,00291 + 0,792 - 0,863 = 999^{gr}93191 ;$$

1000 grammes of water at 4° being equal to 1 litre, the $999^{gr}93191$ are equal to $0^{l}99993191$.

This capacity could yet be determined by means of the following experimental data in which the coefficient of dilatation of the vessel is wanting ;

The volume of the kilogramm n° 6 = 123cc9903 ;

The litre of water at 12° 2 weighs, according to Halstrom, 999gr6989, and according to Despretz, 999gr594 ;

The barometer at 12°2 = 762mm35 and at 0°760mm840 ;

The condensing hygrometer gives the dew at 5°50, hence the elastic force of the vapour 7mm171,

Finally, the temperature of the air 12°2.

I prefer yet the former capacity to that found by calculation by means of the above data ; in the first place, it would differ very little ; besides, for the comparisons, it is more regular to employ this method used by the administration in order to keep up this harmony.

§. 8. Verification of the series of the brass standards.

This series is composed of eleven measures of capacity. They have been treated as the litre.

In order to weigh the water contained, I have used the 6 first weights of the series of weights of the preceding paragraph for the multiples of the litre.

The double decalitre (water at 13°5 ; correction 15gr510).

Water + 15gr510 = 19999.888 ± 0 = 19999gr888 Litres.

20^{l}..... real value = 19.999.888

The decalitre (water at 15° correction 8gr610).

Water + 8gr610 = 9999gr961 — 2gr497 = 9997gr464

10^{l}..... real value = 9.997.464

The half decalitre (water at 14°5, correction 4gr152).

Water + 4gr152 = 5000,0145 — 0gr025 = 4999gr9895

5^{l}..... real value = 4.9999.895

The double litre (water at 14°3, correction 1gr637)

Water + 1gr637 = 1999,9298 — 0gr412 = 1999,5178

2^{l}..... real value = 1.999.5178

The litre (water at 14°0, correction 0gr800).

Water + 0gr800 = 1000,009 — 0,299 = 999gr7019

1^{l}..... real value = 0.999.7019

The half litre (water at 13°5, correction 0gr387).

Water + 0,387 = 500gr000 — 0,123 = 499,878

$0^{l}5$..... real value = 0 9.878

The double decilitre (water at 13°5, correction 0gr155).

Water + 0,155 = 200gr000 — 0,135 = 199.685

$0^{l}2$..... real value = 0.199.865

The decilitre (water at 13°5, correction 0gr078).

Water + 0,078 = 100gr000 — 0,042 = 99,958

$0^{l}1$..... real value = 0.099.958

The half decilitre (water at 13°5, correction 0^{gr}039).

Water + 0,039 = 50^{gr}000 — 0,001 = 49,999

0^{l}05..... real value = 0.049999

The double centilitre (water at 13°5, correction 0^{gr}016)

Water + 0,016 = 20^{gr}000 — 0,006 = 19,094

0^{l}02..... real value = 0.019994

The centilitre (water at 13°5, correction 0^{gr}008).

Water + 0,008 = 10^{gr}000 — 0 = 10^{gr}000

0^{l}01..... real value = 0.010000

If we would calculate these capacities directly, the following elements may be used :

At the beginning of this verification we have had :

For barometrical pressure 764^{mm}40 at 13°0 or H_0 = ... 762.79

— hygrometer, the point of dew at 4°5 f = ... 6^{mm}7

— the temperature of the air at 13°0

At the end of this verification we have had :

For barometrical pressure 763^{mm}95 at 13°0 or H_0 = ... 762.34

— hygrometer, the point of dew at 4°5 f = ... 6^{mm} 7

— the temperature of the air at 13°0.

It would be necessary to ascertain the dilatation of each one of these measures, as well as the volume of each one of the weights used, knowing that the 6 standard kilogrammes in gilt brass have all the same volumee.

§ 4. **Pewter measures of capacity.**

The three series, of eight measures each, being only usual legal forms for liquids, have not been verified anew because they had been stamped by the verifiers of the police of weights and measures. Each one of these series begins at the double-litre, and terminates by the centilitre.

§ 5. **Tin measures.**

The two series of which these measures are composed are used, one vith hooked rectangular handle for the sale of milk, the other with handle for oil; the measures destined for the sale of table-oil bear the mark M, and those designed for the sale of lamp-oil are marked B. All these measures bear the legal police stamp of weights and measures.

These two series are each one composed of seven measures, from the double-litre to the double-centilitre.

§ 6. **Wooden measures for cereals, etc., etc.**

The wooden measures used for dry substances, are of a large capacity. The series is composed of eleven measures, viz. : hectolitre, half-hectolitre, double-decalitre, decalitre, half-decalitre, double-litre, litre, half-litre, double-decilitre, decilitre and half-decilitre. These measures have been verified and stamped by the police of weights and measures. Their verification is operated with small round seed such as rape seed, or any other of regular form. For that operation, use a linen hopper, borded with iron, and fixed close to the table of the press for stamping the measures of capacity; the valve adopted under the hopper permits to the seed used to flow regularly and to settle with uniformity, either to fill up the standards, or to receive the seed thus measured for the standards, after having renowed excess with the rule serving for striker.

The two wooden measures with feet, the hectolitre and the half-hectolitre, are generally used for measuring coal.

The verifiers on circuit, not being able to carry with them such a cumbersome apparatus of verification, have in their travelling work-box a brass rule which, from one of its ends, bears straight notches serving for limits to the height and to the diameter that each one of these wooden measures must have to be of the admissible legal capacity; for, a difference of $\frac{1}{100}$ on the linear dimensions is allowed, in consequence of the contraction of the wood by dessiccation; but this difference must be in excess for the new measures.

CHAPTER IV.

COINS.

The monetary, series joined to the preceding, completes the metrical system; it is connected with it by the weight of its unit, the franc, which is of 5 grammes. This series is the following.

NAME AND VALUE OF THE COINS.	COMPOSITION. Exact.	COMPOSITION. Tolerated	WEIGHT. Exact.	WEIGHT. Tolerated.	DIAMETER.	OBSERVATIONS.
			gr.		millimet.	According to the diameter of the coins, the length of the metre is found by putting end to end :
20 francs.....	Gold.. 0,9	0,002	6,45161	+ 0,002	21	
10 —	Copper 0,1		3,22580	+ 0,002	20	
5 —			25	+ 0,003	37	19 pieces of 5f + 11 of 2f
2 —			10	+ 0,005	27	20 — of 2f + 20 of 1f
1 —	Silver. 0,9	0,003	5	+ 0,005	23	20 — of 5c + 20 of 1f
5 decimes....	Copper 0,1		2,5	+ 0,007	18	29 — of 5c + 7 of 10c
2 —			1	+ 0,010	15	etc.
1 —			20	+ 0,02	31	The pieces of 10 francs are new.
5 centimes...	Pure		10	+ 0,02	27	
2 — ...	copper.		4	+ 0,02	22	The piece of 2 centimes is not yet issued.
1 — ...			2	+ 0,02	18	

The legal value of the coinable metals is as following :

METALS.	PROPORTION	VALUE OF THE KILOGRAMME OF ALLOYAGE AT 0,9. Coined.	OF ALLOYAGE AT 0,9. Bullion.	OF PURE METAL. At par.	OF PURE METAL. At change.
		fr.	fr.	fr. c.	fr. c.
Gold.....	620	3,100	3,094	3,444 44	3,437 77
Silver.....	40	200	198	222 22	220 00
Copper.....	1	5	»	»	»

Nota. The bank-notes of 100 f., 200 f., 500 f. and 1,000 f. issued by the Banking-House continue that series.

The piece or bank-note of 50 f., intermediate element, has not been yet created.

Done at Paris, May 5, 1852.

The Superintendent of the Conservatoire des arts et métiers.

(*Signed*) J. T. SILBERMANN.

Approved :

The general of artillery, member of the Institute, director of the Conservatoire des arts et métiers.

(*Signed*) A. MORIN.

REPORT

ON THE FABRICATION OF FRENCH COINS

BY

Mr B. DURAND
Commissary general of the coins and medals

TO ACCOMPANY

Mr SILBERMANN'S REPORT

ON THE METRICAL WEIGHTS AND MEASURES

Translated from the french

BY

Mr Hippolyte VATTEMARE.

My dear M. Vattemare,

You have invited me, in order to complete a report you intend to address to the Government of the United States, to make known to you:

1° The relation existing betveen our national coins and the decimal system applied to our weights and measures;

2e Our monetary organisation.

I hasten, my dear Sir, to comply with your wishes, begging of you to excuse me, if, in consequence if my occupations, I do not give to those questions the development they deserve. However, I should be most happy if this notice, although incomplete, might be serviceable to the end you aim at.

ON THE DECIMAL SYSTEM APPLIED TO FRENCH COINS.

The intention of the law regulating the decimal system, intention formally expressed, was that the divisional pieces of the monetary unit should correspond with the divisions adopted for the weights and measures; and this was so much the more rational as the calculations applying to coins are, beyond comparison, those most in use; therefore they must be employed as the most efficacious means for rendering the decimal system more familiar to the people, who, usually, have little time to devote to their education.

But what is to be understood by *decimal coins?*

The constitutive law of Germinal 7, an. XI (March, 28,1803) fixed as follows the nature of the pieces that were to be coined:

1° Gold 40 f., 20 f.
2° Silver 5 f., 2 f., 1 f., 3/4 f., 1/2 f., 1/4 f.
3° Copper 10c, 5c, 3c, 2c.

For many persons, these divisions of pieces seem to respond to the question proposed; but it is a grave error, for most of these coins deviate from the decimal division. In fact, the pieces of 40 fr., of 3/4, of 1/4 of franc, and those of 3 centimes do not divide neither 100 nor 10. This last number, which alone is the basis of vulgar numeration, has only two divisors, 2 and 5.

In the nomenclature of weights and measures the multiple units being 10,000, 1,000, 100 aud 10, and the sub-multiple units, 0,1, 0,01, 0,001, the absolute unit 1 has alone a simple name, the multiples and sub-multiples, have compound names, but each of them constantly represents ten in relation with their immediate sub-multiple.

Thus, the *myriagramme* is equal to 10 *kilogrammes*, the *kilogramme* to 10 *hectogrammes*, the *hectogramme* to 10 *decagrammes*, the *decagramme* is itself equal to 10 grammes, etc. The same occurs for the measures of capacity, etc. etc. But, in order to give to the sale of various objects all the desirable conveniency, the following expression has been used; that every unit of decimal measure and weight shall have its double and its half (law of germinal 18, an III).

Now, 2 is the double of each unit separately taken, and 5 is the half of each multiple or sub-multiple unit of 10.

The decimal multiples of the monetary unit only have no compound names; but nevertheless they must be considered as particular units every one of which is ten times greater than the units of next inferior order.

Thus 100 f., value 10 times 10 f., 10 f., ten times 1 f. The franc contains 10 decimes and the decime ten centimes. It is necessary, in order to be consistent with the whole of the system, to apply to coins the division adopted for weights and measures of capacity, for want of which we deviate from the decimal system and the intention of law is disregarded.

Every one sees, in fact, that 40 francs do not divide 100 more than 4 divides 10; that 25, also, is not a decimal divisor, for it is only $2\,^1/_2$ in relation to 10, unit immediately inferior, and $^1/_4$ in relation to 100 unit immediately superior.

So it is for 25 centimes in relation to 1 decime, to 1 franc. These numbers, as divisors of 100 or of 1, return to the binary system which generates unexact fractions. Now, the binary division being completely rejected by the law of July, 4 1837, why should it be left to reproduce itself in coins?

To be consistent with the decimal system and thus to connect the coins with the divisions of 10, so that the absolute monetary unit and every one of its multiple units be expressed, laws and ordinances have modified the law of Germinal 7, an. XI, and have established as follows the divisions of our coins :

1 centime, 10 centimes, 1 franc, 10 francs, 100 francs (1),
The double of which is :
2 centimes, 20 centimes, 2 francs, 20 francs,

(1) The coinage of the 100 francs pieces was authorized by an ordinance of the month of november 1850.

And the half :

5 centimes, 50 centimes, 5 francs, 50 francs (1).

The piece of 1 centime has no half, that of 100 francs has no double.

From purely monetary considerations, the pieces of 100 francs and of 50 francs have not been struk. The piece of 40 francs is yet current ; but the coinage of it has long time since been discontinued.

The coin currency in France is, thus, composed at present :

For	gold,	of pieces of.....	20 fr. and of 10 fr.
—	silver,	—	5 fr., 2 fr., 1 fr., 50 c., 20 c.
—	bronze,	—	10 c., 5 c., 2 c., 1 c.

coins completely decimal.

Allow me, my dear Sir, to notice here a few small errors, without any importance, which have glided into Mr Silbermann's remarkable report on the metrical weights and measures sent to the Government of the United States of America, which report you have been pleased to communicate to me.

Naturally, in my character of a mint officer, I was obliged to pay great attention to the chapter of that report relative to coins, and I have noticed, on one side, that Mr Silbermann, relying upon an ancient and repealed legislation, had given, to certain of our coins, unexact standards, allowances and diameters.

In order to rectify these slight errors, I add to these notes a synoptical table containing all the necessary information on the fabrication of french coins.

On the other hand, in the column of observations of the 1st table of the chapter already noticed, Mr Silbermann expresses the opinion that, according to the diameter of the pieces, put end to end, the length of the metre is to be found. If a comparison similar to that described by Mr Silbermann was possible formerly, it would be destroyed to day by the difference resulting from the letters upon the edge of the coins which are in relief on a great number of our coins, while they were sunken when the contingency of the relation with the metre was established.

I dare believe, my dear Mr Vattemare, that Mr Silbermann will see no captiousness in the very modest observations I took upon myself to make on so small a portion of his remarkable work. Practical men are undoubtedly the last that would give credit to the slightest error.

I come now to the information you have been pleased to ask me on our monetary organisation.

Fabrication of coins. — France has adopted for the fabrication of its coins the system of contract.

This fabrication is entrusted, under the controll and supervision of State, to contractors invested with the title of directors of the fabrication.

The expenses allowed to these contractors, expenses born by the owners of the metals coined, are regulated as follows :

1 fr. 50 c. by kilog. of silver at 900/1000e
And 6 » — of gold at the same standard.

(1) The coinage of the 50 francs piece has not been yet enacted.

In consideration of the sum thus retained, the directors of the fabrication are charged with all the expense of the contract, such as the pay of workmen, the replacement and keeping of all the monetary furniture.

They have likewise to pay for the stamps, the weighing, the calculation and the verification of the pieces coined and put in circulation.

The directors of the fabrication are, besides, obliged to furnish, without any increase of expenses, in divisions of the 5 francs piece, the fourtieth of the amount of the fabrication of silver, say 25,000 francs per million.

These 25,000 francs are thus divided :

5,000 fr.	in pieces of	2 fr.	» c.
12,000	—	of 1	»
6,250	—	of »	50
1,250	—	of »	20
25,000 fr.			

One tenth of the fabrication of gold must be in 10 francs pieces.

There exist in France 7 mints, viz. :

At Paris,
Rouen,
Lyon,
Bordeaux,
Strasbourg,
Marseille,
Lille.

Controll. — The controll and superintendence of the fabrication of coins are entrusted to an administration designated under the title of ***commission of the coins and medals***, This commission is composed of three members, one president and two commissaries general.

Their functions consist in :

1° Deciding the standard and weights of the coins fabricated and superintending, all over France, the execution of the monetary laws, the fabrication of coins and the assay of gold and silver fabrics, etc., etc.;

2° Superintending the operations of all the officers of the mints.

They propose the tariffs determining the standard according to which the coins and gold and silver metals are received in the mints. They order the assay of foreign coins recently fabricated, etc., etc.

According to an ordinance of 1832, they superintend the fabrication of medals, the tariffs of which they propose, and they authorize their delivery and sale.

They are also charged with a controll over the fabrication of plates and the printing of postage stamps, bank notes and playing cards.

The commission of coins and medals is under the authority of the finance department.

There are attached to it :

1° A bureau of assay composed of a verifier, two assayers and a deputy assayer;

2° An engravor general and two deputies engravors;

3° A controller for the fabrication of coins and stamps;

There are in each of the mints, besides the director of the fabrication :
1° A commissary, superintendent;
2° A controller for change;
3° A controller for coining;
4° A clerk.

All the officers and agents charged with the controll and superintendence of the fabrication of coins, receive a fixed salary charged to the public treasury.

Laws and regulations, determining the functions of these various officers, offer sufficient guarantees for the proper execution of our national coins.

Here, my dear Mr Vattemare, the notes you have asked me conclude; they will perhaps be useful to you for comprising their substance in the report you are preparing; I ardently hope they may suffice to the work of devotion and patriotism you have undertaken. Persevere in that path, my dear Sir, in endeavouring to make universal a system which is one of the glories of France. Already in its application to coins, it has had numerous imitators, not only by the adoption of the standard of our coins, of their decimal divisions, of their value, but of our monetary organisation. Belgium, Piedmont, Switzerland, Spain have entered this path. Our coins circulate in those various countries as in France, and likewise in Germany and in a part of America.

Certainly, according to the specimens you have presented to our monetary museum in the name of the United States, the American Government has nothing to envy to any people of old Europe in relation to the beauty of the stamps of their coins; but this is not enough, and the day when the United States will have decidedly adopted the decimal system and inscribed in their laws that: five gramms of silver at the standard of $^{9}/_{10}$ of fineness constitute the monetary unit, they will have enlarged the circle of international exchanges, and resolved the great question of an universal coinage.

I remain, etc.

(Signed) B. DURAND.

We are indebted to the Society of encouragement for the plate belonging to Mr Silbermann's Report.

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45, rue Grenelle-St-Honoré.

Pl. 1265.

...uteur de M. Silber... ...ans le vide,

...e.



Fig. 1.

...e selon M. Silbe...

Fig. 5.

Paris, printed by Paul Dupont,
45, rue Grenelle-St-Honoré.

Pl. 1265.

ateur de M. Silber

ans le vide,

n°.



Fig. 1.

g

e selon M. Silb

Fig. 3.

m



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